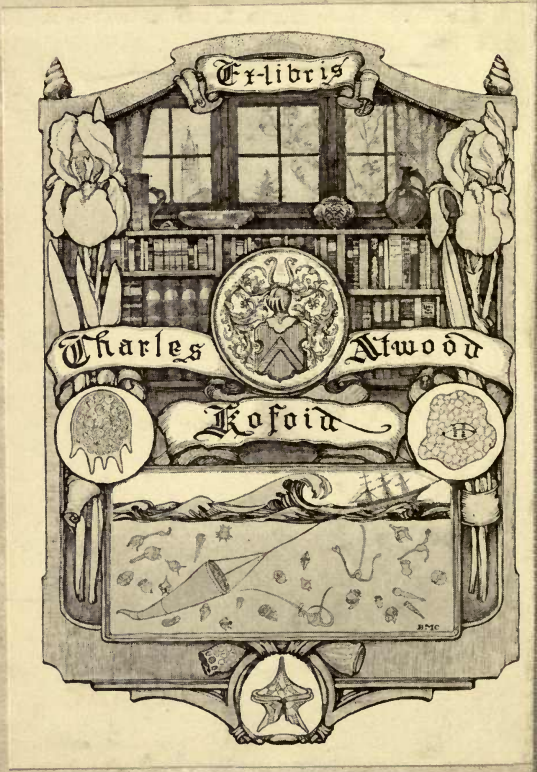

Wm. D. Henkle
Mechanicsburg
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LECTURES

ON THE

ORIGIN OF THE GLOBE—A UNIVERSAL DELUGE—THE DESTRUCTION AND RE-FORMATION OF OUR SOLAR SYSTEM,

THE

ESSENTIAL ELEMENTS OF CREATED PRINCIPLES,

AND THE

ELECTRIC PROPERTIES OF LIGHT, HEAT, &c.

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Author of Lectures upon Education — A New Philosophy of Matter, &c.

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PREFACE.

The train of thought, which led to the production of the first five lectures of the following series, was suggested by a discussion, some two or three years since, with a Swedenborgian. The circumstances, which led to that discussion, were these: Being then the editor of a paper, and having made a remark editorially with regard to some of the opinions of a certain lecturer, upon the Swedenborgian notions of Genesis; he became offended at my dissent from those opinions, and sent me a challenge to debate the question with him. Having made it one invariable rule of my life never to shrink from the responsibility of defending ideas, which I may have advanced upon any subject, I, consequently, accepted the challenge. In the course of the argument, I was surprised at the strong infidel tendency

of his opinions, which tendency became more and more clearly manifest, the further the discussion proceeded.

In combatting, for instance, opinions, which I advanced, respecting the conflagration and disappearance of stars, and the creation of new ones, he quoted Swedenborg, as his authority for the sentiment, that, when the stars disappeared, their light became veiled by an incrustation, like an egg shell, and was thus covered for years or ages, until, at length, by the self moving effervescence of the internal fires, that shell was burst asunder and thrown off around the central light in the form of worlds. Thus he evidently disclaimed, altogether, the agency of the Almighty in the origination of those worlds, and was, so far, a practical atheist.—Other absurdities, contained in the belief of that sect, came to light during that discussion, equally glaring, which convinced me of the infidel character and tendency of their whole system. Their claim to be worshippers of the God of the Bible, weighs not a feather in my

mind, when they virtually *mutilate* that Bible, and give to its Author attributes contrary to those which the Bible gives him. An imaginary Deity, clothed with all the attributes of the Jupiter of heathen mythology, might, for instance, be called by some fanatical errorists, the Jehovah of the Bible. But does that make him so? Certainly not; and we are not bound, by the pretensions of such a claim, to extend *charity* to the error.

These are some of the reasons, which have induced me thus to come before the public with a defence of the *authenticity* and *literality* of Genesis; which defence is sustained by arguments drawn mainly from Astronomy, Geology, and reason.

The last five lectures of the series, are more purely philosophical, and are devoted to the examination and illustration of the organic laws and peculiar properties of electricity, light, heat, and some of the other imponderable agents. The reason why I have introduced such subjects, in connection with a defence

of the Mosaic history of the Origin of the Globe and the Deluge, is, (if apology be needed at all,) because much is said in that defence about the effects of light, in producing the various phenomena of the creations of the six days, and the chemical changes resulting from its agency; and it, therefore, seemed quite appropriate, that the properties and organic laws of light and other chemical agents should be examined, in connection with the other subjects of this work.

Without further remark, by way of introduction, I shall, now, submit, to the candor of the reading public, this effort to defend truth and expose error.

Columbus, Feb'y, 1850.

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LECTURE I.

THE ORIGIN OF OUR GLOBE ASTRONOMICALLY AND GEOLOGICALLY CONSIDERED, AND THE MOSAIC HISTORY OF IT JUSTIFIED AND DEFENDED BY SCIENCE.

A subject, more popular and attractive to the masses than the above, might, I am well aware, have been selected for discussion,—for the public taste has, in a measure, been vitiated by the too great prevalence of frivolous reading matter, but none more intrinsically *important* can be named among all the various topics of remark:—For, certainly, to no higher or nobler purpose can the powers of mind—the force of argument—or the developments of science be devoted, than to the defence of the word and unimpeachable veracity of Him, who established all mental, moral and physical law, from the assaults, which have, from time to time, been made upon them.

Strange, indeed, is it, that there should be any necessity for such a defence; but yet it is as *true* as it is *strange*. With the most plausible sophistries—with an almost unlimited invention of petty quibbles and objections—with an untiring industry, worthy of a better cause—sometimes even with a rankling, spiteful and burning malice, the very incarnation of the pit, have that word and veracity been assailed. But against no

point of the citadel of truth have all these resources of opposition and error been marshalled with more ingenuity, or urged with greater vehemence, or hurled with more dexterity and bitterness, than against the Mosaic history of creation and the deluge, and the testimony of inspiration respecting the final conflagration of our system.

And such has, sometimes, been the fancied success of these assaults, that a loud shout of triumphant exultation has rung through Christendom, as though the impregnable walls of that citadel had been battered down; and the champions of truth have, sometimes, turned pale, and felt the anchor of their hope giving way, and trembled for the consequences, and have, under the influence of such fear, sometimes made unnecessary and unjustifiable concessions, and thereby, in a measure, weakened the positions, which they should have maintained unflinchingly, without one single iota of compromise, keeping ever before them, in characters bright as the pencillings of the sunbeam. "*Truth is mighty and will prevail.*"

With unlimited confidence in the immovable stability and everlasting endurance of this great proposition, I shall proceed, in a series of six or seven lectures, to defend the truth of the Mosaic history of creation and the deluge from the assaults which have been made upon it, as well as the testimony of inspiration respecting the final conflagration and re-formation of our system; and shall attempt to show, wherein injury has been sustained by the zealous but ill advised and misdirected efforts of the champions of revelation.

That we may proceed understandingly and systematically to the performance of our task, I will first mark out the whole field of controversy, and define its boundaries, and reconnoitre the precise position of our adversaries, and describe their armor, and the weapons in which they trust for offensive and defensive warfare.

Marshalled in two grand divisions, the enemies of revelation are arrayed in hostility to the Mosaic history of the origin of the earth, the deluge, and the prophecy respecting the conflagration and re-formation of our globe, mainly upon the ground, or within the field of reason and science, and upon that ground or within that field we shall meet them.

The champions of a rank and bold infidelity head one division. They utterly deny both the authenticity and literality of Genesis and the Bible generally, because, as they affirm, it is inconsistent with reason —because there are discrepancies in the account of creation itself, which can not be satisfactorily explained and reconciled, and because it conflicts, as they affirm, with all the known facts of science and Geology.

The advocates of the dreamy phantasies of Swedenborg head the other division, and, although *apparently* discarding the bold assumptions of infidelity, as untrue, they are, nevertheless, equally enemies of the truth, and inculcate a less open and reckless, but more subtle and dangerous infidelity, inasmuch as its plausible sophistries are much better calculated to mis-

lead and deceive the unwary. They admit, it is true, that Genesis is authentic, but yet entirely fritter away its truth, by denying its *literality*. They affirm that there was no such creation and deluge, as a literal construction of the history would indicate, but that the first eleven chapters of Genesis is an allegory, incomprehensible to the mass of mankind—that the key to this allegory was lost to the world at the confusion of tongues—that Frederick Emanuel Swedenborg has found it, a special revelation having been made to him respecting it, and that he and his initiated followers can alone unlock the hidden arcana of its mysteries.

It is, furthermore, worthy of record and remembrance, that the champions, who head this division of the forces of error, use precisely the same arguments against the *literality* of Genesis, that the champions, who head the other wing of opposition to truth, do against its *authenticity*. And wherein, then is the difference in reality, between them? There certainly *is* none, except that the infidelity of Swedenborgianism is the subtlest and most dangerous of the two.

I will here give a brief outline of their argument, both against the authenticity and literality of Genesis, and then attempt to show that their reasoning is false and inconclusive.

They affirm that there are discrepancies in the Mosaic account of creation itself, which cannot be reconciled, inasmuch as it is said that light was created upon the *first* day, whereas the sun was not, according to the same account, created until the *fourth* day, and

they, therefore, affirm that the whole history is unphilosophical, since light could not exist before the sun—that, if the record of the six days creation be intended to be regarded as *literal*, the world is not, according to that history, but about six thousand years old, which, as they affirm, conflicts with the known and acknowledged facts of Geology, by which it is proved to *be* myriads of ages more,—that it is contrary to every principle of reason and philosophy to suppose that the deluge should so overflow the whole earth, as to submerge it beneath the water fifteen cubits below the tops of the highest mountains, and that the entire history is, therefore, altogether unworthy of belief, if regarded as anything but an ingenious allegory.

Now, in my answer to these objections of Swedenborgianism and infidelity, I shall assume the proposition, that the history contained in the first eleven chapters of Genesis is both *authentic* and *literal*, and that, if the original Hebrew be properly construed and understood, that history does not conflict *at all* with the known and acknowledged facts of Geology, nor with any sound principle of reason or philosophy.

I am aware that, in thus assuming that the history is both authentic and strictly literal, I object to certain admissions, which have been made by the champions and defenders of the Mosaic account. But, in justification of such a course, I have reasons to urge, the validity of which forcibly impress my own mind. I think those admissions have been very incautiously and injudiciously as well as unjustifiably made, and have, in many cases, materially weakened the defence of

those champions, and unnecessarily given their opponents the decided advantage in the discussion.

It is a settled principle of interpretation, I believe, and one perfectly correct, that, in an apparent narration of facts, if there be nothing preceding it, or in the narration itself, which indicates a figure, a parable or an allegory, it is uniformly to be regarded as *literal*. Any other rule would inevitably introduce complete confusion and perplexing uncertainty into the medium for the conveyance of thought or of intellectual impressions from mind to mind, and every man, however wild and crazy in his notions of things, would accommodate the language to his own mental vagaries, and build upon it his own peculiar fabric of mysticism, having his own peculiar key to unlock its meaning.

It is, then, I say, an established rule of interpretation, that every statement, purporting to be a statement of facts, should be construed literally, according to the comprehension of unsophisticated minds, unless the narrator intimates by either the text or context, that he is uttering or writing parables or allegories.

Now let us apply this rule to the matter under discussion. There is no indication whatever, in the Mosaic account of creation, of any thing but a plain, straight forward narrative of events, which actually and literally transpired, exactly in the order in which they were described. Any other hypothesis would create confusion in our ideas—would send the honest enquirer after truth afloat upon a dark and wild ocean

of doubt and uncertainty, without compass, or rudder, or helmsman.

There is something, for illustration, directly to this point in the matter under discussion. When it is affirmed in the narrative of Genesis, that "the evening and the morning were the first day," we must either regard it as a single revolution of the earth upon its axis, which constitutes a literal "evening and morning" or else, the moment we depart from its strict literality, and admit that the days spoken of might be each of them many hundreds or many thousands of years or ages, we can then, set no boundaries at all to the extent of the figure, and, at once lose sight of all reliable landmarks in the discussion. The objector may then very plausibly and justifiably declare, that we have no authority whatever to assert, for the sake of convenience, or to help ourselves out of a dilemma, that a part of the narrative of Genesis is figurative and a part literal. He may very justly require that we should make the narrative either *entirely figurative* or *entirely literal*, and not make it the one or the other, just so far as it may happen to suit our purposes or convenience. I cheerfully concede, and *must*, in honesty, concede, that he is right in the requirement.

But it may be asked by some of the champions of revelation, whether, by assuming this position of strict literality, I do not, in fact, deny the well attested facts of Geology. Not at all. For I consider a well authenticated and indisputable fact of Geology, just as worthy of implicit belief, as an equally well authenti-

cated and indisputable fact of revelation, for both facts had their origin in the same reliable source, and both emanated from the same fountain of eternal truth. The same Being, whose hand, in the exertion of its resistless Omnipotence, formed and moulded each geological stratification of the globe, in its respective order, gave utterance, also, to each recorded fact and event mentioned in revelation. Both Geology and Revelation must, then, of necessity harmonize perfectly, and instead of conflicting, as the sceptic affirms, must mutually corroborate the truth of each other. Instead, therefore, of attempting, in this discussion, to array Revelation against the facts of Science, or Science against the facts of Revelation, I shall regard them both as equally true and equally worthy of implicit confidence, and shall use them as mutual elucidators of each other's meaning.

Now, one thought more upon the subject of strict literality, and I will dismiss the subject. The great fountain of all wisdom and knowledge must be quite as felicitous in his choice of language to convey his meaning, as the most critical and acute philologist. He uses no word at random, or loosely and ambiguously, when conveying his thoughts and purposes. Every phrase signifies precisely what it was intended to signify. He must, also, know perfectly the mental calibre and strength of understanding of those to whom he condescends to communicate his thoughts. When, for instance, he made a revelation to man, he knew precisely what man was, and of course, he made

it to be *understood* by man, or else it was no revelation at all; for that, which purports to be a revelation, must, of course, be communicated in language *to be understood* by those to whom it is addressed, or else it is *no* revelation certainly, but a tantalizing deception—a mockery, to which no pure and benevolent being would stoop. God, then, who cannot stoop to any such deception and mockery, made that revelation to man to be understood, without relying upon the aid of Frederick Emanuel Swedenborg to help him explain himself, by unlocking the arcana of mysteries, otherwise sealed and incomprehensible without his aid—a man who violates every single rational, common sense, reliable principle of interpretation—who distorts language with all the wildness and incoherence of insanity—who impiously arrogates that important revelations have been made to him by Deity, and yet is the author of a book "*concerning conjugial and scortatory love*," which ought to be classed with the very filthiest of obscene publications, unfit to be seen in any decent family, and richly worthy of being presented, as an intolerable nuisance, by every grand jury in the nation.

We draw this conclusion, then, from what has been said, that, when the Deity made a plain statement of certain facts, as those regarding creation, he expected, doubtless, that they would be received *as* facts, addressed to the comprehension of common minds. Any other supposition would be a libel upon the fountain of all wisdom and knowledge.

I must, then, from our deductions, regard the Mosaic account as literally true, and proceed, as best I can, to show how the facts of Geology can be reconciled with that account, or that account with the facts of Geology: For I hold it to be a proposition, capable of incontrovertible proof, that every fact made known by Deity, in the revelation of his creation, has its corresponding fact in Geology, which exactly coincides and must, *of necessity*, exactly coincide with it, whether with my limited research and finite powers of mind, I can discover that coincidence or not.

We will now commence a careful and critical review of the history of creation in Genesis, and examine it step by step to ascertain its real meaning, bringing in the aid of science and reason to explain and elucidate its extreme brevity.

When it is said that—"In the beginning God created the heavens, and the earth," it is generally understood by the phrase, I believe, that the Deity, then, *originated from non-entity* the material, out of which our system was formed. Now, in a discussion, where important truths are at stake, I regard it as a very inexpedient policy to assume that anything is a positive fact, past controversy, contradiction or doubt, if it be at all doubtful. Such an unwise course only weakens the position it was intended to strengthen, and gives an opponent of real truth a decided advantage. Such has been the case in my estimation with regard to the first verse of Genesis. The original Hebrew word,

translated—"*created*"—in that connection, does not necessarily signify an absolute origination of material from nothing, for the word is used elsewhere to signify the modification of material which already existed, and I shall not, therefore, for the reasons before stated, so consider it, since such an assumption is not at all essential to the validity of our argument. That material, I am willing to concede, might, from aught that appears in the Hebrew idiom, have existed, in other forms, for untold ages previous to this grand event, and might, for aught we can say to the contrary, have undergone ten thousand various transformations before, in accordance with the phenomena of ceaseless change which Astronomy reveals. In conceding this point, I concede nothing worth controversy to the objector. It is entirely immaterial to our argument, whether it were then originated, or whether it had undergone innumerable changes and modifications previously. Let it not, however, for a moment be understood, that in making this concession, I concede, also, that the same material might have existed eternally and been unoriginated; for I admit no such thing. There was a period of time in the untold ages of the past, when it must, in the very inherent necessity of things, have been originated from non-entity. For it could easily be shown, by a process of incontrovertible reasoning, which, however, is foreign from the present discussion, that there could not possibly exist together two co-eternal, self-existent essences; so that, if *mind* be eternal, *matter* cannot be, and must, therefore, of

necessity, be under the control of that eternal mind, and must have been originated.

We will here introduce a quotation from the British Cyclopedia, which coincides, in a measure, with the view above expressed of the first verse of Genesis.

"Creation, in its strict and primary sense, denotes the causing of a substance or being to exist, which had no existence before; and, therefore, it implies no contradiction. That there is one underived and self-existing cause from which all other beings derive their existence, and upon which they entirely depend, is a truth capable of incontestable demonstration. Consequently, all beings, except the first cause, must have been produced, or brought into being, by the power and agency of the first cause; not produced "out of nothing," as some have inaccurately expressed it, but out of nothing besides the immense and inconceivable fullness of the self-existent being, who must have in himself the power and possibility of all being; though we cannot comprehend or conceive in what manner, or by what kind of agency, he creates or communicates existence to beings distinct from himself. The term "creation" is used, in a secondary and less proper sense, where any particular bodies are formed out of such a mass of matter as seems to be entirely unfit for that purpose; when such changes are made in any substance as are generally supposed to be above the power of creatures, and to belong to God alone:—thus God created fish and fowls out of the water, and man and beasts out of the earth;

though the creation of the substance of water or earth, or the matter out of which they were made, is the original sense of the word. The Hebrew word, (Gen. i, 1.) rendered "created" has, it is said, chiefly on the authority of Maimonides, been considered as implying what theologians call "an absolute creation out of nothing." But this, it has been alleged, is not its appropriate meaning. It rather means to *fashion*, *form* and *decorate*, a matter already existing; and in this connection especially it means to retrieve from a state of desolation, and to embellish this little spot of earth, so as to render it fit for its inhabitants. In this limited sense God is afterwards (ch. ii, 7,) said to have *created* man, not out of nothing, but out of the dust of the ground. Joshua (xviii, 15, 18,) bids the children of Joshua *create* to themselves a more ample possession, by cutting down the woods. Goliath (1 Sam. xvii, 8,) desires the Israelites to *create*, that is, *choose* or *prepare*, a proper champion to fight with him. In Numb. xvi, 30; 1 Kings xii, 33; and Nehem. vi, 8, it signifies to *devise*, as it is rendered in the cited passage of Kings; and the word *devise* would have been more proper in the other places."

Again the same authority makes the conclusive remark, "upon the whole we may observe, that it seems to have been a current opinion among the ancient Jews and earliest Christians, that the world was created by God of pre-existing, unfashioned matter. The matter of which the Earth was created, or rendered

a habitable world, was "without form and void," (v. 2,) or a desolate waste, or in a state of dissolution; that is, as some have supposed, a pre-existing earth reduced by some awful calamity to a chaotic state."

As we shall be required, in the proper illustration of our subject, to take notice of the various changes which are going on among the systems of the starry heavens, it may not be inappropriate here to make the passing remark, that the very fact of those changes, proves that matter is not eternal, for, if it were it would not change, and that the self-existent and eternal Essence which produces and controls these changes *must* himself be *unchangeable* and everlastingly the same.

We will now glance at some of the startling phenomena of mutation which Astronomy reveals, so that we may call in the important aid of analogy to the defence of the positions, which we may, hereafter, assume. And here I will introduce several facts from Burritt's Geography of the Heavens, from which I design to draw certain conclusions. They relate to the wonderful disappearance and re-formation of fixed stars or suns.

"Two hundred and fifty years ago, a bright star shone, five degrees north-northeast of the star Caph, in the constellation of Cassiopeia, where now is a dark void!"

"On the 8th of November, 1572, Tycho Brahe and Cornelius Gemma saw a star in the constellation

of Cassiopeia, which became, all at once, so brilliant, that it surpassed the splendor of the brightest planets, and might be seen even at noonday! Gradually, this great brilliancy diminished, until the 15th of March, 1753, when, without moving from its place, it became utterly extinct.

"Its color, during this time, exhibited all the phenomena of a prodigious flame—first it was of a dazzling white, then of a reddish yellow, and lastly of an ashy paleness, in which its light expired. It is impossible, says Mrs. Somerville, to imagine anything more tremendous than a conflagration that could be visible at such a distance. It was seen for sixteen months.

"Some astronomers imagined that it would reappear again after 150 years; but it has never been discovered since. This phenomena alarmed all the astronomers of the age, who beheld it; and many of them wrote dissertations concerning it.

"Another instance of the same kind was observed in 1604, when a star of the first magnitude suddenly appeared in the right foot of Ophiuchus. It presented, like the former, all the phenomena of a prodigious flame, being, at first, of a dazzling white, then of a reddish yellow, and lastly, of a leaden paleness; in which its light expired. These instances prove that the stars are subject to great physical revolutions.

"Rev. Professor Vince, one of the most learned and pious astronomers of the age, has this remark:—

The disappearance of the stars may be the destruction of their system at the time appointed by the Deity for the probation of its inhabitants; and the appearance of new stars may be the formation of new systems for new races of beings then called into existence to adore the works of the Creator."

"Thus, we may conceive the Deity to have been employed from all eternity, and thus he may continue to be employed for endless ages; forming new systems of beings to adore him; and transplanting beings already formed into happier regions, who will continue to rise higher and higher in their enjoyments, and go on to contemplate system after system through the boundless universe.

"La Place says:—As to those stars which suddenly shine forth with a very vivid light, and then immediately disappear, it is extremely probable that great conflagrations produced by extraordinary causes take place on their surface. This conjecture, continues he, is confirmed by their change of color, which is analogous to that presented to us upon the earth by those bodies which are set on fire, and are, then, gradually extinguished.

The late eminent Dr. Mason Good observes, that "worlds and systems of worlds are not only being perpetually created, but are also perpetually disappearing. It is an extraordinary fact, that, within the period of the last century, not less than thirteen stars in different constellations seem to have totally perished, and ten new ones have been created. In many

instances it is unquestionable that the stars themselves, the supposed habitation of other kinds and orders of intelligent beings, together with the different planets, by which it is probable they were surrounded, have utterly vanished, and the spots, which they occupied in the heavens, have become blanks!"

Aside from the consideration of the grandeur and sublimity of the ideas contained in the above extracts, I have been influenced in their selection for the sake of certain practical conclusions, relevant to the subject under discussion, which I design to draw from the interesting and startling facts, which they unfold.

Those stars, whose wonderful disappearance is thus spoken of, were suns, and, reasoning from analogy we must conclude that they were not isolated—that they shone not on empty space in vain, but that they were surrounded, like our sun, with their attendant retinue of worlds or opaque bodies, which revolved around their central and guiding influences. Now when any one of those fixed stars or suns disappeared from the heavens—when, for instance, that in the constellation of Cassiopeia expired in such a remarkable manner, what became of the planets, which were controled in their movements by its light and heat? Why, they, doubtless, perished with it; as all mere matter must, when the controlling element of light is withdrawn from it. For should our sun, for instance, be suddenly blotted from the heavens, the order and regularity of the whole solar system would be instantane-

ously destroyed, and all the planets, which compose that system, would rush headlong to anarchy and chaos.

Another important query here naturally suggests itself in connection with the subject under discussion. When the star in 1572 increased so immensely in size and brilliancy, as to present the appearance of a tremendous conflagration, what supplied the fuel for that conflagration, which was so intensely luminous as to be apparent to astronomers of our globe more than forty millions of millions of miles distant. The circumstances of the case press with great urgency for a definite and satisfactory answer; for, never was there, be it remembered, an effect without a cause, or a cause without an effect—never was there a fire without fuel or combustible materials of some sort to make it! The only answer to this question, then, which I can conceive as at all appropriate or reasonable, is, that the law of centripetal and centrifugal force, which kept the opaque worlds that surrounded that star so perfectly balanced in their several spheres up to the time appointed for its destruction, was suspended by the same Almighty power that enacted that law, and, then, those planets, no longer balanced in their orbits, must have rushed into the great central fires of their system, and been buried beneath its ocean waves of flame ten thousand times ten thousand cubits deeper, than was this globe of ours beneath the waters of the deluge of Noah. The necessary result of such a grand catastrophe would have been a vast increase of the size of that star, and would have produced a con-

flagration so prodigious as to be noticed some forty millions of millions of miles distant by Tycho Brahe, the astronomer of our globe, who observed it.

But some one may here ask the question whether that sun was hot enough thus to burn up its dependent worlds, since some philosophers assume that the suns or fixed stars of the universe are nothing more than opaque bodies themselves, surrounded by a luminous atmosphere?

To answer this question satisfactorily, as we imagine can easily be done, we must appeal to *facts*, which are the only safe criteria, whereby to form a judgment. It was estimated, for instance, by Sir Isaac Newton, and other astronomers of the day, who carefully computed the elements of the celebrated comet of 1680, that it approached only within *one million and three hundred thousand miles* of the surface of the sun, and yet that it was heated, even at that distance, *two thousand times hotter than* red hot iron—hotter, indeed, by several degrees, than was sufficient to burn up and completely vaporize any known substance within the compass of our observation. If then, at the distance 1,300,000 miles from the surface of the sun, the heat be so intense as to burn up and vaporize any substance with which we are acquainted, even including the rock-ribbed hills of granite, what must have been its effect upon worlds plunged beneath its mountainous waves of fire? Why surely, just what Tycho Brahe saw in 1572—a conflagration so

enormous, as to astonish astronomers millions of millions of miles distant.

But again, was that star *large* enough thus to engulph its dependent worlds within its capacious vortex of etherial fire? By analogy we infer that it was.

Had the appointed time now come, for instance, long since predicted in the Bible, for the dissolution by fire of our system, and for the melting and burning of our elements by fervent heat, how could the great event be accomplished? It is a known fact, the result of accurate mathematical calculation, that the aggregate magnitude of all the primary planets with their attendant satellites, put them all together, would be over *one million and three hundred thousand times less* than the bulk of the sun. To acquire, so far as possible, an adequate idea of its immense comparative bulk, and to fill the mind, in some measure, with the grandeur of the subject, I will here quote a remark or two from Burritt. "Of a body so vast in its dimensions, the human mind, with all its efforts, can form no adequate conception. The whole distance between the earth and the moon would not suffice to embrace one third of its diameter. "Were the sun a hollow sphere, perforated with a thousand openings to admit the twinklings of the luminous atmosphere around it—and were a globe as large as the earth placed at its centre, with a satellite as large as our moon, and at the same distance from it as she is from the earth, there would be present to the eye of a spectator on the interior globe, a universe as splendid

as that which now appears to the uninstructed eye—a universe as large and extensive as the whole creation was conceived to be, in the infancy of astronomy."

It must be apparent then from what has been said, that the sun is large enough to engulph all the planets that surround it ten thousand times ten thousand fathoms beneath its ocean waves of etherial fire. By analogy we infer, then, that the star, which burnt out in 1572 was large enough thus to swallow up and devour its whole retinue of dependent worlds.

Now, if fixed stars have been burnt out, and have disappeared from the heavens, leaving their places a blank, as is a well attested fact of science, and if, as is very probable, these dependent worlds have supplied the fuel for that immense conflagration, what has become of the material of those suns and worlds? Was it annihilated? From analogy I conclude not. Whenever there is a destruction, for instance, of any combustible material by fire, annihilation is not a necessary consequence. Not a single particle of its resulting elements is lost. They all exist some where, either in smoke, or in the gasses, or in ashes. When water becomes united with heat, it passes into an aeriform condition, and is magnified some eighteen hundred or two thousand times. Each minute particle forms a little vesicle or minute balloon filled with caloric, but still there is no diminution of its substance by the change. You have only to abstract the caloric to condense it into water again, having the same bulk as it had before vaporization.

Now, what is the rational conclusion with regard to the star of 1572, or that of 1604 in the right foot of the constellation of Ophiuchus, or of that of any other star, which has thus burnt out and disappeared? Why, that the opaque bodies, which surrounded them, were precipitated into them — were vaporized by their intense heat — the material of each was united with the other, as is always the case with caloric and opaque matter, when brought into contact in certain proportions—being vaporized, it became vastly magnified and aeriform in its character, and disappeared from its former fixed location and floated away through space, to mingle, probably, with the nebulous matter, or irresolvable star dust of the skies, which is, doubtless, the faintly luminous and vaporized material of burnt out worlds and suns, held there in chemical union by some mysterious bond, until, by the all creating fiat of the Almighty, it shall be ordered to some appointed spot of the universe, — be there separated, the opaque matter by itself, and the caloric, which holds it in a state of vaporization, by itself, — and there be re-formed by the Omnific Word, which every where controls it, into another solar system, taking its place again among the clusters of some one of the constellations. Is this mere fiction, or sportive ideality? Is there, in fact, any other rational solution of the question with which we started? Is there any other more satisfactory theory to account for the phenomena of the luminous nebulae or irresolvable star dust of the skies, than that it is the vaporized material of burnt out suns and

worlds held in aeriform condition by caloric, the great vaporizing agent, and rendered slightly phosphorescent or luminous in its appearance, by the excess of the caloric of each sun over the bulk of its dependent worlds, as we have seen is the case, by a comparison of the solar system; for were the material of our sun and worlds to be vaporized and held in chemical union, the caloric so far exceeds, in bulk, the opaque matter, that the vapor must *necessarially* be *luminous.*

Now, if, in such matters, we have any right at all to draw conclusions from scientific analogies, and I believe we have, for God invites investigation of his works, then, I conceive, that this is precisely the phenomena which is described in the second and third verses of Genesis. Mark the language of that record. It was true, and will be found, scrutinize it closely as you may, to coincide with all true science. "The earth was without form and void"—that is,—there was nothing but perfect vacuum, so far as mere matter is concerned, where it now hangs, "and darkness was upon the face of the deep." Yes, the vast space now occupied by our solar system, might well be called a "deep"—"a void"—or vacuum—a blank ocean, whose immensity can scarcely be fathomed or comprehended by finite minds.

Sirius, the bright star in the constellation Canis major, is considered the nearest fixed star to our earth, and yet its distance is computed to be twenty millions of millions of miles from us—a distance so great, that a cannon ball, flying at the rate of nineteen miles

a minute, would be two millions of years in passing over the mighty interval, while sound, moving at the rate of thirteen miles a minute, would not reach it in less than three millions of years."* This distance, however, is only a part of one of the radii shooting out from the centre of this ocean of space, occupied by our system, the whole diameter of which, must have been more than forty millions of millions of miles, and whose cubic bulk must have been past all finite comprehension. "Darkness was upon the face of this deep," as there was nothing throughout the whole boundaries of its "void" or vacuum to illuminate it. And the important hour had now come to fill this "void." "The Spirit of God moved upon the face of the *waters*." This is the language of our translation with which, from careful investigation, I am not entirely satisfied. The Hebrew of the original will bear a different construction. We may safely and appropriately render it—"The Spirit of God brooded upon the surface of the billowy confusion"—that is, upon the vaporous masses of matter that had been decomposed by the convulsion of some previous destruction and reduced to a chaotic state.

Now where was the material which constituted this billowy confusion? Was it in the "void" spoken of? I apprehend that it could not have been. Nothing was there but a blank—a "void" throughout whose vast extent "darkness" rested. But the ma-

* Vide Burritt's Geography of the Heavens.

terial, which constituted this "billowy confusion" was something, and had a location. Now was it not the vaporous and chaotic elements of burnt out systems, since the material of lost suns and worlds must exist somewhere in space in a state of decomposition, unless, when they so wonderfully disappeared, they were absolutely annihilated, for which hypothesis we have no proof at all? Was it not the billowy material of the floating and irresolvable nebulæ? By the investigations I have made, I prefer this as the most rational and philosophical hypothesis, the one best calculated to rescue the Mosaic history from the difficulties which surround it and defend it from the subtle objections whcih are urged against it.

Upon these vapours—these billowy masses, "the Spirit of God moved" with energizing power. Then was issued that omnific mandate, which Longinus and others have so much admired for its sublimity, grandeur and brevity:—"And God said, let there be light and there was light." Light, where? Why, light diffused through that "deep," where "darkness" dwelt before. Was it there previously, or its material? No, for the space was a "void" previously. It must either have been originated then, or been *ordered* there. It certainly was not *originated* then, for "the Spirit of God had just moved upon a" material, which existed. The rational conclusion then is, that, when the "Spirit of God moved upon the billowy masses," they were the luminous nebulous masses of the sky; and when "God said, let there be light, and there

was light," so much of that luminous star-dust, as had been "moved" upon, energized, and separated; obeyed, instantaneously, the will of its sovereign, and filled the "void" of the "deep" with its luminousness, upon whose "face" "darkness" had brooded before. This light certainly, which God then spoke into existence, was not the sun; for, the sun was not created until the fourth day, an account of which is contained in the fourteenth, fifteenth and sixteenth verses of the same Chapter.

As this is a very important point to establish, and as the validity of our theory depends upon it, I shall, in my next lecture, consider, more at large, the character of the nebulæ, and bring to our aid the discoveries of astronomers in this department of Science.

LECTURE II.

THE ORIGIN OF OUR GLOBE ASTRONOMICALLY AND GEOLOGICALLY CONSIDERED, AND THE MOSAIC HISTORY OF IT JUSTIFIED AND DEFENDED BY SCIENCE.

If I am diffuse in my remarks, and the chain of argument appears protracted and attenuated, my justification is, in the novelty of the positions I take, and the necessity of being very explicit in their defence. For this reason I shall quote from Burritt a condensed view of all the various discoveries which have been made with regard to the nebulæ, so that we may have, in one view before us, every aspect of the subject, which has either a favorable or an unfavorable bearing upon our theory.

"The nebulæ, so called from their dim, cloudy appearance, form another class of objects which furnish matter for curious speculation and conjecture, respecting the formation and structure of the sidereal heavens. When examined with a telescope of moderate powers, the greater part of the nebulæ are distinctly perceived to be composed of little stars, imperceptible to the naked eye, because, on account of their apparent proximity, the rays of light proceeding from each are blended together, in such a manner as to produce only a confused luminous appearance.

In other nebulæ, however, no individual stars can be perceived, even through the best telescopes; and the nebulæ exhibit only the appearance of a self-luminous or phosphorescent patch of gaseous vapor, though it is possible that even in this case, the appearance may be owing to a congeries of stars so minute, or so distant, as not to afford, singly, sufficient light to make an impression on the eye. In some instances a nebulæ presents the appearance of a faint luminous atmosphere, of a circular form, and of large extent, surrounding a central star of considerable brilliancy.

One of the most remarkable nebulæ is in the sword handle of Orion. It is formed of little flocky masses, like wisps of cloud, which seem to adhere to many small stars at its outskirts. It is not very unlike the mottling of the sun's disc, but of a coarser grain, and with darker intervals. These wisps of light, however, present no appearance of being composed of small stars; but in the intervals between them, we fancy that we see stars, or that, could we strain our sight a little more, we could see them. These intervals may be compared to openings in the firmament, through which, as through a window, we seem to get a glimpse of the heavens, and brighter regions beyond.

Another very remarkable nebulæ is that in the girdle of Andromeda, which, on account of its being visible to the naked eye, has been known since the earliest ages of astronomy. It is often mistaken for a

comet, by those unacquainted with the heavens. Marius, who noticed it in 1612, describes its appearance as that of a candle, shining through horn. Its form is a long oval, increasing by insensible gradations of brightness, from the circumference to a central point, which, though very much brighter than the rest, is not a star, but only a nebulæ in a high state of condensation.

No power of vision hitherto directed to this nebulæ has been able to resolve it into the least appearance of stars. It occupies an area comparatively large—equal to that of the moon in quadrature. This nebulæ may be considered as a type, on a large scale, of a very numerous class of nebulæ, of a round or oval figure, increasing more or less in density towards the centre.

Annular nebulæ also exist, but are among the rarest objects in the heavens. The most conspicuous of this class, is to be found exactly half-way between the stars Beta and Gamma Lyræ, and may be seen with a telescope of moderate power. It is small, and particularly well defined; appearing like a flat oval ring. The central opening is not entirely dark, but is filled with a faint, heavy light, uniformly spread over it, like a fine gauze stretched over a hoop.

Planetary nebulæ are very extraordinary objects. They have, as their name imports, the appearance of planets, with round or slightly oval disks, somewhat mottled, but approaching, in some instances, to the vividness of actual planets. Some of them, upon the supposition that they are equally distant from us with

the stars, must be of enormous magnitude. That one, for instance, which is situated in the left hand of Aquarius, must have a volume vast enough, upon the lowest computation, to fill the whole orbit of Herschel.

The nebulæ furnish an inexhaustible field of speculation and conjecture. That by far the larger number of them consists of stars, there can be little doubt; and in the interminable range of system upon system, and firmament upon firmament, which we thus catch a glimpse of, the imagination is bewildered and lost. Sir William Herschel, conjectured that the nebulæ might form the materials out of which nature elaborated new suns and systems, or replenished the wasted light of older ones. But the little we know of the physical constitution of these sidereal masses, is altogether insufficient to warrant such a conclusion.

There is a luminous zone or pathway of singular whiteness, varying from four degrees to twenty degrees in width, which passes quite round the heavens. The Greeks called it Galaxy, on account of its color and appearance: the Latins, for the same reason, called it Via Lactae, which, in our tongue, is Milky Way.

Of all the constellations which the heavens exhibit to our view, this fills the mind with the most indescribable grandeur and amazement. When we consider what unnumbered millions of mighty suns compose this cluster, whose distance is so vast that the strongest telescope can hardly separate their mingled twilight into distinct specks, and that the most con-

tiguous of any two of them may be as far asunder as our sun is from them, we fall as far short of adequate language to express our ideas of such immensity, as we do of instruments to measure its boundaries. It is one of the recent achievements of astronomy that has resolved the Milky Way into an infinite number of small stars, whose confused and feeble lustre occasions that peculiar whiteness which we see in a clear evening, when the moon is absent. It is also a recent and well accredited doctrine of astronomy, that all the stars in the universe are arranged into clusters, or groups, which are called Nebulæ or Starry Systems, each of which consist of many thousand of stars.

The fixed star which we call our sun, belongs, it is said to that extensive nebulæ, the Milky Way; and although apparently at such an immeasurable distance from its fellows, is, doubtless, as near to any one of them, as they are to one another.

Of the number and economy of the stars which compose this group, we have very little exact knowledge. Dr. Herschel informs us that, with his best glasses, he saw and counted 588 stars in a single spot, without moving his telescope; and as the gradual motion of the earth carried these out of view and introduced others successively in their places, while he kept his telescope steadily fixed to one point, there passed over his field of vision, in the space of one quarter of an hour, no less than one hundred and sixteen thousand stars, and at another time in forty-one

minutes, no less than two hundred and forty-eight thousand.

In all parts of the Milky Way he found the stars unequally dispersed, and appearing to arrange themselves into separate clusters. In the small space, for example, between Beta and Sad'r, in Cgyni, the stars seem to be clustering in two divisions, each division containing upwards of one hundred and sixty-five thousand stars.

At other observations, when examining a section of the Milky Way, not apparently more than a yard in breadth, and six in length, he discovered fifty thousand stars, large enough to be distinctly counted; and he suspected thrice as many more, which, for want of sufficient light in his telescope, he saw only now and then. It appears from numerous observations that various changes are taking place among the nebulæ, that several nebulæ are formed by the dissolution of larger ones and that many nebulæ of this kind are at present detaching themselves from the Milky Way. In that part of it which is in the body of Scorpio, there is a large opening, 4 degrees broad, almost destitute of stars. These changes seem to indicate that mighty movements and vast operations are continually going on in the distant regions of the universe, upon a scale of magnitude and grandeur which baffles the human understanding.

More than two thousand five hundred nebulæ have already been observed; and, if each of them contains as many stars as the Milky Way, several hundreds of

millions of stars must exist, even within that portion of the heavens which lies open to our observations:

> "O what a confluence of etherial fires,
> From urns unnumber'd down the steep of heaven
> Streams to a point, and empties on the sight."

Although the Milky Way is more or less visible at all seasons of the year, yet it is seen to the best advantage during the months of July, August, September, and October. When Lyræ is on, or near the meridian, it may be seen stretching obliquely over the heavens from northeast to southwest, gradually moving over the firmament in common with other constellations.

Its form, breadth and appearance are various, in different parts of its course. In some places it is dense and luminous; in others, it is scattered and faint. Its breadth is often not more then five degrees; though sometimes it is ten or fifteen degrees, and even twenty. In some places it assumes a double path, but for the most part single. There are several other nebulæ in the heavens as large as the Milky Way, not visible to the naked eye, which may exhibit the phenomenon of a lucid zone to the planetary worlds that may be placed within them."

Having quoted above, all the discoveries of astronomers respecting the nebulæ, I am aware that the objection will here be strongly urged against the views we have taken, that, since a proportion of their expanse has been resolved into stars, the *whole* might, therefore, be. But some of them, be it remembered, which are apparently as much within the ken of the

telescope, as others, have remained irresolvable, and, before the power of the best glasses that have ever been invented or constructed, have presented nothing but a hazy, vaporous luminousness, and, doubtless, will forever continue to present such an appearance, being in reality, utterly irresolvable. We must reason from the facts which the discoveries of science have actually given us and not from any conjectured facts which some future scientific discoveries may peradventure bring to light.

Now these irresolvable nebulæ, which, by some mysterious attraction are mostly drawn to a certain section of the universe and there form a luminous belt or zone of enormous circumference, may, as I have already observed, be the decomposed material of lost systems, "out of which," as Herschell very properly remarks in the extract, which we have quoted, "nature," or I would rather say Deity, "elaborates *new suns and systems.*" It is also remarked in the same extract that "several nebulæ are formed by the dissolution of larger ones, and that many of this kind are detaching themselves from the Milky Way."

Now this is precisely such a phenomenon as was presented to the universe, if our theory be correct; at the glorious spectacle of which "the morning stars sang together, and all the sons of God shouted for joy." So much of the *luminous nebulæ, or light*, as would fill the immense "void" where our system is located, was "detached" in the language of the extract, and ordered

into that space, where "darkness" dwelt before, and was there "elaborated into a new sun and system."

And now, before this theory, what becomes of the objection, upon which infidels have laid so much stress, that *light* could not exist before the sun. It vanishes in a moment. So then, here upon the *very ground*, where the objector to the authenticity and literality of Genesis had proudly taken his stand, confident of triumph, the truth,—never foiled—mighty to conquer,—will prevail over him. This very objection itself can be used against him with irresistible keenness, and, "like Damascus blades without their hilts—all edge" —will wound him wherever he seizes hold of it.

The word in the original Hebrew, translated "light" in the third verse of the first chapter of Genesis, is different altogether from that translated "lights" in the fourteenth, fifteenth and sixteenth verses of the same chapter, and which has reference to the sun, moon and planets, created upon the fourth day. The two have a different signification. The word translated "light" in the third verse is "*aour*" in Hebrew, "*phose*" in Greek, and "*lux*" in Latin, which signifies *light in a state of diffusion* rather than light in a body; while that, translated "lights" in the fourteenth, fifteenth and sixteenth verses, is "*mart*" in Hebrew, "*phostares*" in Greek, and "*luminares*" in Latin, which signify "*enlighteners*," or light condensed into a focus, or collected into a body like the sun.

Now all the supposed discrepancy of Genesis vanish-

es in a moment before a proper understanding of its real meaning. The light of the third verse is not an "*enlightener*" in the sense of "*mart*"—that is, not light in a body, shedding from a concentrated focus, its rays upon other bodies or other matter, but simply light in a diffused state, which it appears to me, can be no other than the floating nebulous masses of luminous vapor or star-dust as I have supposed, and this is the "*aour*" with which the Omnific Word filled the "deep," where darkness before brooded, when "God said, let there be light and there was light."

What now becomes of the luminous matter, thus ordered into the space, occupied by our present Solar System? The very next verse will answer the question, and bring us one important step nearer to the consummation of our argument, and will, further, prove conclusively, that we need no better guide, in this discussion, than the word itself, properly understood.

After God had said, "let there be light," and the great "void" of the "deep" had been filled up with it, he next does precisely what we should suppose he would, if our theory be correct. "And God saw the light that it was good"—in amount and quality just as he would have it, and just as he had ordered it,—"*and God divided the light from the darkness.*" Now what does this remarkable expression mean; for it has a *definite* meaning, and a meaning very different, I imagine, from that generally ascribed to it? Was a sun then created? No. Was light collected

into a body? No;—for that was not done until the fourth day. But a *separation* is produced. Now, a separation of what? Why of "*light*" from "*darkness.*" But what does this singular expression mean? "Light" has no more communion or union with "darkness," in the common acceptation of the term "darkness," than "Christ has with Belial." There certainly can be no chemical combination whatever between the two, simply in themselves considered. For where light is, there is no darkness at all, and can be none—as the term darkness is generally understood. What, then, does this *division*—this *separation* mean,—for, although Moses has been sneered at, as being ignorant and unphilosophical, yet it may eventually be satisfactorily proven, that he was far more philosophical than his arrogant deriders—what, then, I say, does it mean?

Why, if the material, with which the "void" of the "deep" was filled, was the nebulous vapour of the skies, and, if that nebulous vapour was the material of suns and worlds combined in chemical union by conflagration, as we have supposed, then is there a wonderful, most beautiful and philosophical appropriateness in the language, and the critical acumen of Moses, and, through him, of Eternal Wisdom, is fully justified and defended against the profane witicisms and blackguard sarcasms of self-opinionated fools. When "God *divided* the light from the darkness," he simply dissolved the connection, or chemical union, which conflagration had formed between the two, by

abstracting the *caloric* from the *dark opaque* material, with which it had been combined. What followed? Why the vapour ceased to be vapour any longer, as is always the case when caloric is abstracted from it, and so the liberated material returned to its native dark state, and was, of course, immensely condensed from its gasseous condition.

That is the only "division" indicated by the passage, which I consider as at all appropriate, and I am unwilling to dishonor the great Fountain of all wisdom and knowledge so much, as to concede for a moment, that he cannot use language quite as appropriately as the very wisest and most learned of his puny and short sighted revilers. The very original Hebrew word, translated "divided," indicates just such a chemical decomposition as we have supposed, for the Lexicon, in giving its definitions of the word "*divided*" refers to this very verse, and construes it to mean, "*a separation of things mixed together or united.*" So that the Mosaic history is carefully and wisely guarded against the puny assaults and malicious misinterpretations of its adversaries.

Was a sun now made of the caloric or light? Not yet. It was still "*aour*"— still light unconcentrated into a focus — still light in diffusion. Almighty Power, for the wisest purposes — for he does nothing in vain,—separated, doubtless, the light to one part of the space, occupied by the solar system — perhaps to the centre — still however, spread undoubtedly, judging from the testimony in the case, as well as from

geological data, over a vast area like a nebulæ, as before, yet more intense — being free caloric — that is — being pure and uncombined — and, then, he distributed the opaque material, thus separated and divided into planets, into other parts of that same space, as he would have them located, at various and appropriate distances from the separated central light, though as yet that light was not intense enough to give them visibility by its reflection from their opacity.

And now what occurred? Why, a revolution of the earth upon its axis, and probably of all the other planets, took place, which constituted the first "day" and "night" or "the evening and the morning" of the "first day;" since it is a conceded point among all philosophers, that light controls the movements of the planetary worlds, and if *now*, it certainly must have done it *then*.

Now I hold that that revolution, which constituted the "first day" was a *single, literal revolution of the earth upon* upon its axis, as I assumed at the outset of my argument, and, here we now come to the *supposed discrepancy* which is urged to exist between Geology and the authenticity and *strict literality* of Genesis; which supposed discrepancy can, I believe, upon correct and *acknowledged* scientific principles, be fully shown to be *no discrepancy at all.*

At this progressive stage of creation, what now was the condition of our earth, provided that our premises and consequent deductions from them be correct, when the caloric was abstracted, and its chemical

union was dissolved by Almighty agency and it was reduced from its æriform condition? This question can be satisfactorily answered by imagining what it *would* be, *now*, had its oceans, seas, lakes, fountains and solid earth and rocks been all vaporized together by an amount of heat sufficiently intense to do it, and, then, had that caloric been abstracted by any means from the resulting vapor, and been again condensed from its gasseous condition. As the *water* of our globe far exceeds the amount of the land, the material, when condensed from vapor would have been precisely in that soft, plastic condition, in which both Geology and Genesis shows it to have been at its origin. Water and the more solid particles of the material *must have been in a commingled* and fluid mass, but in the lapse of time, the heavier particles would have gradually settled down or gravitated towards the centre of that mass, by degrees have become solid there, and water, being the lighter element, must have covered its entire surface to a considerable depth, and constituted one unbroken expanse of ocean. Instead of conflicting with true science, then, how beautifully geological is the Mosaic history; for, in this view of the subject, it harmonizes *precisely* with the whole testimony of Geology.

Now in this condition of things, what must have been the effect of the "*aour*," or nebulous, unconcentrated light upon it, supposing it to have been as far removed from the centre of that light, as it now is

from the centre of our present sun? Let us make a calculation. Suppose that that light was diffused over a space in bulk five or six million times greater than that occupied by the sun as it now appears, which, it must be presumed was the case, both from the facts of Geology and Genesis. Then, as light,—by a known and invariable law—diverges according to the squares of the distance in passing from a luminous body, its effect, according to this hypothesis, in producing the motions of the earth and the planets, *must* have been several million times *less intense* upon them than it is now. And what would have been the necessary consequence? Why, the movement of the earth upon its axis must have been *exceedingly slow and scarcely perceptible.* Provided that light was several million times less intense upon the earth, as it must necessarily have been, and, as light is, most certainly, God's agent to govern and control all its motions, then *must* it have been *several* million times longer in making its first rotation upon its axis, which constituted its "first day," than it is at present. So then, upon this hypothesis—an hypothesis actually and surely built upon the facts recorded in Genesis, the first rotation of the earth *might* have been just as many, and *was* just as many ages as the facts of Geology indicate, and *yet* have constituted but a *single, literal* "evening and morning," which produced the "first day" of creation.

After having, for the sake of the contrast, quoted at some length, the vague notions, which have been

entertained by the champions of Genesis, as well as its antagonists, I will then show what must have necessarily been the Geological formations of the "first day," if our theory be correct.

The British Cyclopedia makes the following remarks upon the subjects under discussion, which I will here insert for the sake of contrasting our views.

"The first step in the recovery of the earth from its chaotic or desolate state, and the commencement of the six days' creation, was the production of light. This operation is expressed in the original with a beautiful conciseness which even Longinus has admired, and better rendered by Wickliff than in our translation, "Be light: and light was." The light here mentioned, says a learned annotator, (Dr. Geddes,) may readily be conceived to have been a partial incipient light, which progressively penetrating the dense atmosphere that enveloped the sea-covered earth, as to admit the clear and uninterrupted sight of the celestial luminaries. The appearance of light three days before what some conceive to have been the creation of the sun has occasioned a difficulty, which indeed is not easily resolved upon this hypothesis. Some, as Dr. Taylor, in his "Scripture Divinity," and the author of "Nature Displayed," have adopted the notion that light is a distinct substance from every other, and that it exists independently of the sun and other luminous bodies; and that these serve merely to excite. Light, say they, exists in a state of expansion or diffusion through the whole universe, and at all times,

by night as well as by day; and that, in our system, the sun is the great exciter, by which the substance of light is impelled, and becomes visible: and they add, that if no substance of light previously existed through the whole system, no light would appear, though ten thousand suns should at once be placed in our hemisphere. Hence it is argued, that the element or substance of light was created on the first day, and that the divine power alone might be the exciter, which made the light appear for the three first days of creation, until the sun, the instrumental exciter was produced. "God," says the author, "was the parent of light, and it was created by his almighty fiat, before there was a sun to dart it over one part of the earth, and a moon to reflect it on the other." (See also Patrick on Genesis i. 3, &c.) But waiving any remarks on this hypothesis; it is more reasonable to conceive, as others have done, that the light, which was made to appear on the first day, was nothing more nor less than an emanation from the same sun, previously existing, that still enlightens us; and which, though it had not yet appeared in its full glory, yet shed sufficient light through the dense atmosphere to make the surface of the terraqueous globe visible. This was evidently the idea of Origen, and probably of Basil also. The former affirms that no one of a sane mind can imagine that there was an evening and morning, during the three first days, without a sun: the latter ascribes the darkness that covered the earth, before the appearance of light, to the interposition of a dense body."

We shall, without stopping to comment at present, continue our extracts upon the subjects under discussion from the same authority.

"Many absurdities have been charged both by ancient and modern writers, upon the Mosaic account of creation; some of which, we conceive, might have been precluded by restricting this account to the formation of the creation of the sun, moon, and stars, which are here mentioned merely as they bear relation to the earth, and some for its accommodation. According to this interpretation, the operation of the fourth day was not the creation of the sun, moon, and stars, but that of assigning to them their appropriate use, with respect to the new formed earth. The whole passage describing this operation may be read from a collection of different copies, in the following manner, (v. 14—18):—"Let there be luminaries in the expanse of the heavens, to illuminate the earth, and to distinguish the day from the night; let them, also, be the signals of terms, times and years." "And let them be for luminaries in the expanse of the heavens, to illuminate the earth, (conjectured to be an interpolation,) and so it was. For God having made the two great luminaries (the greater luminary for the regulation of the day, and the smaller luminary for the regulation of the night) and the stars; he displayed them in the expanse of the heavens to illuminate the earth, to regulate the day and the night, and to distinguish the light from the darkness." Dr Geddes, in a note on v. 14, "let there be luminaries," &c., observes, that it is not necessa-

ry to suppose that these luminaries, were now first created. The text does not say so, and there are many strong reasons for believing the contrary. The objection that may seem to arise from v. 16, "God made two great lights," &c. in our version has no force but what it derives from theological systems, and an ignorance of the Hebrew idiom. To *make* is often equivalent to *appoint* to a certain use; the luminaries, then, may have long existed, and most probably did long exist before this period; although now, for the first time, they shone forth in their full splendor on this little world of man. The opinion above stated, was maintained not only by the most learned of the Jewish rabbins, but by the most learned of the Christian writers. Origen affirms, as we have already observed, that "no man of a sound mind can imagine, that there were an evening and a morning, during the first three days, without a sun." St. Basil ascribed the darkness that covered the earth, before the appearance of light, to the interposition of an opaque body between it and the heavens. In this simple hypothesis, the whole Hebrew cosmogony is clear and consistent. It is plain that the light, if it emanated from the sun, or were excited by the sun, could not, even imperfectly, illuminate more than one half of the world at once; and while that half was illuminated, the other would remain in darkness; and this is fitly called "separating the light from the darkness," namely, by that ever-changing boundary the "horizon." But in order to move this boundary and to carry alternate light and darkness to

every part of the globe, it was necessary either to make the sun revolve gradually round the earth, or the earth to turn gradually round its own supposed axis toward the sun; which latter motion we now know to be the fact. Light being thus separated from darkness by the aforesaid ideal boundary, they would follow one another without interruption, and produce successively those vicissitudes which we call "day" and "night," two other terms, only, for "light" and "darkness;" and the former, being justly considered as the principal and most precious portion of time, an entire revolution of light and darkness was denominated "one day;" the "evening" being the term of "light," and the morning" the term of "darkness."

By the "six days," in which the work of creation is said to have been performed, the generality of critics and commentators have understood, literally and strictly, so many days. Some of them have understood as many years; some, in order to favor a slow progressive creation, have made one day a period of 1000 years; and others, again, have thought the creation of the world to have been instantaneous, and that the number of days mentioned by Moses is intended only to assist our conception, who are best able to think of things in the order of succession. It has also been supposed, that the distribution of the work of creation into six days, followed by a day of rest, was designed to enforce the observance of a weekly sabbath, both as a day of religious worship, and as a day of solacing repose to the human, and even to the brute creation.

Many among the ancients and moderns have objected to a literal interpretation of the cosmogony of Moses. Whilst it has been a source of doubts and difficulties to the best commentators, it has furnished occasion of indecorous and misapplied raillery and ridicule to the enemies of revealed religion in all ages. Eusebeus, by way of apology for the Mosaic account of creation, says, (Presp. Evang. I. ii. 7,) "that it was not Moses' intention to give a philosophical account of the formation of the world, but to signify only, that it did not exist of itself, or by chance, but was the production of an all-wise and powerful Creator." Cyril makes a similar reply to the scoffs of Julian, "that Moses' view was to accommodate his story to the ignorance of the Jews; not to reason accurately on the origin of things, but to show that there was one God who created them all." (Julian, Oper. and Cyril Contr. Vol. ii, 1, 3, p. 50, &c., Ed. Leps.) Philo, (Cosmop. 1. i, tom. i, p. 123,) calls it a "piece of rustic simplicity to imagine that God really employed the labor of six days in the production of things;" in which he is followed by Origen, Austin, Ambrose, &c. Accordingly, several ancient writers have adopted an allegorical interpretation. Josephus, in the first chapter of his "Jewish Antiquities," intimates, "that the story of the creation was of the allegoric kind." Philo is evidently of the same opinion. Among the moderns, and especially among those who have been referred to the class of sceptical writers, the same allegorical interpretation has generally been adopted.—

See Blunt's "Oracles of Reason;" Tolland's "Pantheistican;" and "Letters to Ierena;" Burnett's "Archaeologia," (1. ii, c. 7, 9;) Middleton's "Essay on the Allegorical and Literal Interpretation of the Creation and Fall of Man," in his "works," vol. ii, p. 123—126, and his "Examination of Sherlock's discourse on Prophecy," in his "works," vol. iii, p. 192, &c. Dr. Burnett, in particular, maintains that the Mosaic account was merely a *fable*, though, according to this representation of it, a fable too absurd for a wise man, and much more for an inspired person to have formed. But surely there can be no reason for admitting this hypothesis, if the literal interpretation be capable of a philosophical explanation; more especially as Moses does not inform us where his fable ends, and where his true history begins, and as Christ and his Apostles refer to the story of the creation and that of the fall (see fall,) inseparably connected with it, not as an *allegory*, but *true history*. 2 Cor. iv, 6; xi, 15. 1 Cor. xv, 45. Matt. xix, 4, 5. 1 Tim. ii, 13, 14. 1 Cor. xi, 9. Besides, it is not very natural to suppose that God would so solemnly, from Mount Sinai, make the circumstances of a fable the foundation of the fourth commandment. Exod. xx, 11. Heb. iv, 3, 4.

A late biblical critic (see Dr. Geddes' critical remarks, vol. 1,) rejects both the literal narration and the pure allegory, and alleges that the Mosaic account is a most beautiful *mythos*, or philosophical fiction, contrived with great wisdom, dressed up in the garb

of real history, adapted to the shallow intellects of a rude barbarous nation, and perfectly well calculated for the great and good purposes for which it was contrived; namely, to establish the belief of one supreme God and Creator, in opposition to the various and wild systems of idolatry which then prevailed; and to enforce the observance of a periodical day to be chiefly devoted to the service of that Creator, and the solacing repose of his creatures. In fact, says this writer, what stronger motive could be urged to preserve a people from idolatry, than by showing, in so minute a detail, that all the worship-objects of the surrounding nations were themselves but mere creatures, the great celestial luminaries (most probably the first objects of adoration,) not excepted? He had, no doubt, particularly in view the idolatry of Egypt; where, as Bassent elegantly says, "Tout etoit Dieu, excèptè Dièu mème; et cete Terre, qu'il avoit fait, pour y manifester sa gloire, sembloit ètre devenue un temple d'-Idoles." (Disc. sur. 1. Hist. Univ.) Beside the sun. moon, and stars, they adored the fishes of the sea the birds of the air, the animals of the earth, and even the herbs of the field, radishes, leeks and onions.— "O sanctas gentes: quibus haec nascuntur in hortis Numina!"

It was then of the utmost importance to persuade the Israelites, who had during their stay in Egypt, been more or less contaminated by those idolatrous rites, that every plant of the field, fish of the sea, bird of the air, and beast of the earth; the whole visible

world, in short, was the production of a superior Being, to whom alone divine worship could be due. In particular by the great quadrupeds and the great sea-monsters, it is supposed that he alluded in the former, to the worship of Apis in the form of a bull, and in the latter to a crocodile, which, in some parts of Egypt, was held in the greatest veneration. The hypothesis, says Dr. Geddes, of a mere partical mythos, historically adapted to the senses and intellects of a rude unphilosophical people, will remove every obstacle, obviate every objection, and repel every sarcasm; whether it came from a Celsus or Prophyry, a Julian or a Frederick, a Boulanges or a Bolingbroke.

As we have already exceeded the proper boundaries of a single lecture, I shall defer to my next, such remarks as the last quotations may suggest.

LECTURE III.

THE ORIGIN OF OUR GLOBE ASTRONOMICALLY AND GEOLOGICALLY CONSIDERED, AND THE MOSAIC HISTORY OF IT JUSTIFIED AND DEFENDED BY SCIENCE.

Not having had space in my last lecture for comments upon the closing extracts, which I quoted for the sake of reviewing some of the singular opinions expressed in them upon the subjects under discussion, I will here recur to them again. From them it will be forcibly apparent, that learned men will sometimes entertain and give utterance to most consummate philosophical nonsense, so to speak, when struggling to account for difficulties, without the proper data, from which to reason, and such a knowledge of facts and analogies, as is indispensable to guide one correctly through long chains of intricate deduction to legitimate conclusions.

The idea expressed in one of the extracts, that, "if 10,000 suns should, at once, be placed in our hemisphere," "no light would appear," "unless the substance of light previously existed through the whole system" is a rare specimen of "confusion worse confounded"—the grossest solecism—a perfect contradiction in terms, which no scholar would perpetrate, unless he had got into an inextricable dilemma, and knew no *other* way of getting out again. It is, in

fact, saying that suns can exist without shedding their rays, which is the same as asserting the self evident contradiction in terms, that *light* can exist *without* light—a most heathenish blunder. How infinitely better it is to meet acknowledged difficulties fairly and boldly, as we find them, and attempt to solve them *just as we find them*, upon rational and common sense principles, instead of perpetrating such puerile inconsistencies, or resorting to the miserable subterfuge of sophistry.

But I must defer any further comment upon the various unphilosophical opinions contained in those quotations, until we come to that part of the present lecture, where we speak of the creations of the fourth day, remarking, however, in the present connection, that, before the explanation we have made, many of the difficulties, which have perplexed philosophers and have environed the subject, will vanish, and there be no necessity for resorting to absurd hypotheses to obviate those difficulties.

We now come naturally to the consideration of the geological formations of the "first day," or to what is technically denominated, the "Cambrian or Graywake and the Silurian systems," which constituted the *Primary fossiliferous period.* Was the condition of things, which our theory supposed to have existed during the first day of creation, congenial to the production of all those fossiliferous remains and geological phenomena, which the primary period reveals, for if not, it cannot be sustained, however plausible,

since, as we have assumed, the facts of Revelation and Geology must of necessity, harmonize, emanating as they do, from the same source or authorship? Let us examine the subject and decide this question according to the evidence, which may come before us.

1st. The organic remains of the primary fossiliferous period are marine animals and plants, which agree so far, *entirely* with our view of the oceanic submersion of our globe during the first day.

2d. Those organic remains were the zoophytic tribes among the animals, and the flowerless plants and algæ, chiefly or entirely marine, among the vegetable classes. Now these, both animal and vegetable, were the very feeblest forms of life, but one slight progression from the condition of absolute inanimate substances.

Nearly the whole zoophytic tribes, in every variety of their organization, were exceedingly sluggish and almost inert, scarcely moving from the spot in which they were born during the whole period of their existence.

Now let us apply the test of these facts to our theory. Was there aught in our supposed primary condition of things, calculated to sustain and foster such feeble life? Most certainly. For if animals and vegetables require caloric to sustain them, as no philosopher who understands the subject will deny, and if the vigor and energy of that life is, within certain limited boundaries, in proportion to the amount of caloric, as is equally undeniable, then is there a *definite*

reason in our theory, why the primary animal and vegetable organizations should have been so sluggish and of such a character. The light being, according to our hypothesis, several million times less intense upon the globe than it is now, would, of course, in amount, be precisely calculated to foster and sustain just such a feeble race of animals and vegetables as existed during the period of the first day. Indeed, had the light been any more intense than it then was, it is presumable that such organizations could not have existed exactly in the form they then existed, but must, doubtless, have perished, and that is very probably the reason why they became, in a great measure, extinct, when light became more intense or concentrated.

3d. There is abundant evidence, derived from the acute investigations of geologists, that the various organizations of this period, which constituted its fossiliferous petrifactions, required a perfect quiescence of the waters in which they were generated. Some of the champions of the Mosaic history "maintain," I am aware, "that the fossiliferous rocks of the primary formation were not the result of slow deposition and consolidation," but might have been deposited by the deluge of Noah. This supposition is not, however, sustained by the facts in the case, for there must have been a violent and tumultuous action of the waters of the globe during that remarkable convulsion, "for the ocean must have flowed over the land in strong currents; and, when it retired, urged on as it was" by the resistless pressure of a gale, similar currents must

have prevailed, which must have entirely precluded the possibility of such a deposition of organic remains, as Geology reveals, since they, evidently, required a quiescent location. They were, doubtless, deposited, then, during some more favorable period, long previous to the Noachian deluge.

Now it is worthy of consideration, whether our theory concerning the condition of the earth during the first day, would not be more favorable in producing that quiescent state of the waters which must have existed throughout the long lapse of time required for the deposition of the fossiliferous rocks of the primary formation. We think it would, and for these reasons:

1st. The ocean could not have been agitated then as it is now, by the rapid rotation of the earth upon its axis every twenty-four hours, causing, of necessity, changes of temperature and windy currents.

2d. Another very important reason why the waters of the ocean must have been quiescent is, the fact that there was no revolution of the earth around the sun, because there was, as yet, *no* sun. We know that the earth now moves in its orbit at the mean rate of sixty-eight thousand miles in an hour. Being whirled at such prodigious velocity through space, there must, of necessity, be produced some agitation among the fluids upon its surface, either by the rapidity of its motion, or the change of temperature and variable currents of wind consequent upon it.

3d. A quiescent condition of the water must have been the result of another fact. There were, undoubt-

edly, *no tides* then as there is now, since the influence of the moon, in the production of those tides could not have been the same that it is at present, as it rotated not around the earth, and reflected not the light of the sun as it now does. There could then have been no oceanic currents produced by this cause.

4th. But the most important reason of all, and one of itself sufficient to account for the perfect quiescent condition of the waters at the geological period of the deposition of the fossiliferous rocks, is, the fact that there was *no atmosphere*, and of course *no wind*, and therefore, *no currents* produced by wind.

But here, undoubtedly, will be urged a serious objection to our theory. It is this. If, as we have assumed, the earth might have been as many thousand years as the primary geological formations indicate, in performing its first rotation on its axis, that half of it which must have been consequently turned, for ages, away from the light, must,—the objector will strongly urge—have been *congealed to* an immense ice-berg. But he must recollect that, in drawing this conclusion, he is reasoning from false premises, without the data of facts to sustain his argument. He reasons, for instance, from the *present* condition of our globe, which is unwarrantable. Having ascertained that the oceans of the Arctic and Antarctic regions, when turned away from the sun for six months of the year, become congealed to ice-bergs, he concludes that the same must be the case with the earth under the circumstances which we have supposed to exist. But he must recol-

lect that there is no parallel between the two cases. There was then no rotation of the earth upon its axis in twenty four hours as now—there was no revolution yearly around the sun to produce a variation of temperature from heat to cold or from cold to heat—there was no atmosphere to lower the temperature by currents of wind, or to carry off the caloric by evaporation. Besides, having been recently reduced to its plastic condition, it was less dense than it is now, and, therefore, more pervious to heat. Now being in this perfect quiescent, and almost immoveable condition without any medium by which caloric could have been carried off, the whole mass of waters must have been so completely pervaded by it, that its temperature must have been nearly equal on all sides of the globe, and the half of it which was turned away from the light, could not, therefore, have been frozen by any means to an ice-berg, as the objector supposes.

Now here existed an order of things, it seems to me, precisely, and most admirably adapted to generate, during the supposed long period which intervened between the creation and the second day, all those zoophytic and other forms of feeble life, which followed each other in a succession of generation after generation, until their remains were consolidated into the fossiliferous rocks of the Graywake and Silurian systems, to the depth of over sixteen thousand feet.

Having no data, whereby to form a correct judgment as to the rapidity of the successive generations of those primary forms of existence, no geologist is

able to decide positively as to the length of the period required for the production of the primary fossiliferous stratifications. But one thing, I think, is certain — that we have *here* a perfect solution of the apparent discrepency, which has seemed to exist between the Mosaic history thus far considered, and Geology.

Whether the chronological data of the scientific, with regard to the length of time required for the geological formations of this period, are correct or not, remains yet to be proven. For one, I am inclined to think their orthodoxy extremely problematical. Since commencing my investigations of this subject, with reference to a publication of their results, I have, in the course of my reading, met with some novel and highly interesting calculations upon the subject of these data, with which I have been much pleased, and which are contained in a work entitled, "Letters on Geology," by David Christy, Esq., who has made extensive geological researches in Ohio, and in the western sections of the Union. I will here insert his remarks upon this subject entire.

"There are many of my friends who are unwilling to think favorably of the study of geology, because of its supposed infidel tendencies. These suspicions have been strengthened by the writings of a few doctors of divinity, who have undertaken to reconcile certain geological speculations with the Mosaic account of the creation; or, rather, who have adopted a new rule of interpretation to suit the geological theories.

"The vast thickness of the formations of fossil bearing rocks, some of which are almost wholly composed of pe-

trified sea shells, have led some to suppose that many millions of years would be required for the propagation and accumulation of such immense quantities of organic remains, or beings, once possessing life.

"The common Bible chronology gives 1656 years from the creation to the deluge. Doubts, however, exist, as to the accuracy of this computation, and some prefer that of the Septuagint, which allows about 2000 years to have passed away before that period.

"Geological researches have shown, that a period of comparative repose existed in the beds of the ancient oceans, of sufficient duration to allow of the formation of a vast thickness of rocky strata. [See Letter to M. de Verneuil.] These strata were produced by the influx of sedimentary matter into the seas from the rivers and coasts, and by the propagation of the shells and corals existing in the ocean, and which, in the process, were buried by the sediment, and afterward petrified. The strata of rocks formed during this period are the *Silurian*, *Devonian*, and *Carboniferous* formations. Their average thickness will not exceed five miles in depth, and the area covered by them will not equal more than one half of the land now above the level of the ocean.

"Now the problem to be solved is this: How long would it take the causes in operation, in the earlier period of the world's history; that is, the natural increase of the sea shells then living, together with the sedimentary matter brought in constantly by rivers from the uplands and by tides from the coasts, to produce an extent of rocks equal to the formations above mentioned?

"I have this object in view, in instituting the inquiry. I wish to shew that there is no certainty in any geological estimates when applied to *time*. The reason why I make

such a positive declaration, is because we cannot form any just conception of the extent of the agencies which were in operation in the production of the earlier secondary rocks. And we know about as little of the rate at which such formations may now be accumulating in the depths of the sea.

"I shall pass by the quantity of sedimentary matter received by the ocean from the lands, and base my estimates upon the shells alone. The formations above named, I will suppose to have been produced between the creation and the deluge, a period, say, of 2000 years. The investigations in these formations have discovered near three thousand species. There are but few of these shells which occupy a less space than one tenth of a cubic inch, and some of them will equal a cubic inch, and others much larger. Marine shell-fish are known to propagate very abundantly — indeed, nearly equal to the herring.

"To obtain the information I desired, I addressed a note to the Professor of Mathematics in Miami University, T. J. MATTHEWS, and have received the following reply:

'*Question.* Suppose 3000 species of animals, one pair of each species to commence bearing young after one year, to continue bearing yearly for the ten following years, and all their progeny to continue bearing according to the same law, the annual rate of increase being ten for each pair, what will be their number at the end of 2000 years; and how many cubic miles (if they be supposed to be shell fish,) will they occupy, supposing each one to be one tenth of a cubic inch in magnitude?

'The object of this question, I understand to be, to ascertain whether the vast amount of fossil remains, disclosed by geological researches, can be accounted for, by any reasonable rate of increase, within a period of 2000 years.

'In order to meet this object, it is not necessary to calculate the result of the above question, by including all the particulars there given. I shall, therefore, state the question as follows:

'Suppose one female to bear *five* young for one year, and then cease bearing, each one of the progeny bearing according to the same law for 2000 years, what will be their number? &c.

'It is well known that the expression for the sum of a geometrical series, is,

$$N = \frac{r^n - 1}{r - 1}$$

when N, is the number, or sum of the series, r, the ratio, or rate of increase, and n, the number of terms.

For the present question, this formula becomes,

$$N = \frac{5^{2000} - 1 = 5^{2000}}{5 - 1 \quad 5 - 1}$$

omitting the unit in the numerator as inconsiderable; therefore,

$$\log. N = 2000. \log. 5 - \log. 4.$$

Therefore, $\log. N = 1397.33794$, and

$$N = 21775000, \&c., \text{ to } 1398 \text{ places of figures.}$$

'If each occupy one tenth of a cubic inch of space, the number contained in a cubic mile will be expressed in sixteen places of figures; dividing the whole number of shells by the number contained in a cubic mile, will give the number of cubic miles occupied by the whole number. Now a number consisting of 1398 places of figures, divided by a number consisting of sixteen places of figures, gives a number containing 1382 places of figures. To write this number down would require nearly one page of

foolscap paper; to numerate it would be next to impossible; to conceive of it would be quite impossible.

'If we wish to ascertain the cubic space in cubic miles; that is, the length, breadth, and height, of the whole space, in linear miles, considering it as a cube, or having equal sides, divide 1398 by 3, and the quotient, 466, is the number of places of figures representing the miles in each side. Now a billion is expressed by ten figures; divide 466 by 10, and 46 will be the number of repetitions of billions; that is, the number of miles in each side, will be billions of billions of billions of billions, repeated 46 times.

'Of course the above calculation takes no account of the philosophical question as to how much of the shelly matter of one generation may be redissolved, and go to the formation of succeeding generations. The question is answered in its strict and literal sense, supposing each individual to be formed of matter furnished by the great reservoir of the ocean, independent of all others.'

"Having received the above lucid statement, and its results having been much beyond what I conceived would be the bulk in the time specified, I addressed another note to the Professor, asking him to state the number of cubic miles in the earth, and its comparative size to the cubic miles in the above calculation. His reply follows:

'The diameter of the earth being 7912 miles, the number of cubic miles contained in it, is 259,333,411,700, about, and the number of such globes contained in the space occupied by the shells would be expressed by 1382—12= 1370 places of figures.'

"It should be particularly noticed that this estimate takes but *one* species, instead of *three thousand*, the true number; that *one tenth* of a cubic inch is much below the average size; and, also, that an increase of five *for one*

year only, instead of, perhaps, one hundred for ten years, reduces the estimate low enough to satisfy any one. And yet the results are astounding. The cubic miles in the earth are expressed by twelve figures. The natural increase of one species alone, at the rate above stated, in 2000 years, produces a mass of matter which would make as many billions of worlds, as large as the earth, as is expressed, not by 12 places of figures, which is the size of the earth, but by 1370 places of figures."

We have dwelt minutely upon the fossiliferous formations of the primary period, because *here*, mainly, the Mosaic account of creation has been supposed to conflict with the facts of Geology. Having done so, there will be no necessity for dwelling, with such minuteness, upon the history of the remaining days, we shall therefore consider them much more briefly.

The next step in the process of creation was the production, by the Almighty, of the expanse, or atmosphere, which surrounds the Earth. This must have vastly changed the previous condition of the globe. There was now a medium for evaporation, and a new element, upon which the vapors could be borne and the clouds formed, which existed not during the first day. The waters of the globe must now have become more agitated than before,—the temperature of the atmosphere, being necessarily variable, must have begun to produce currents of wind, —these must have disturbed the former quiescence of the water—and the consequence must have been the extinction of many of the previous forms of life,

which accords exactly with the discovered facts of Geology. But the places of these extinguished existences were supplied by the creation of new orders of being, adapted to the changed condition of the globe.

Another important result was produced by the creation of this new element. As, according to computation, the atmosphere extends forty-five miles above the earth, it became a medium to sustain a vast amount of vapor, which was now to be separated from the waters of the Ocean, so that their amount might, thereby, be lessened, and the dry land the sooner appear.

The period of this creation constituted the evening and morning of the "*second day,*" which was a literal revolution of the earth upon its axis, but yet another immense period of time — one as long as Geology indicates,— for not yet was the light gathered into the focal intensity of a sun, although that light might have been much more concentrated than during the first day, which the fossiliferous formations of this period indicate, and it would, therefore, have been shorter than the first day though very long.

On the third day the waters of the Globe were collected together into separated oceans, seas, and lakes, and the dry land was made to appear, very probably by the upheaving of its submerged surface into heights or mountains, by the action of subterranean fires or chemical agencies, which had been generated during the immense period of the two previous days, leaving

corresponding cavities for the water. And now grass, and trees, and fruit, were produced, but the light was not yet formed into a sun, although the geological formations of this period indicate a still greater condensation than heretofore.

Now the caviler may affect to scoff at the gradual condensation of light, but if he does he scoffs also at some of the well attested discoveries of Astronomy. Sir William Herschel draws the conclusion, from certain appearances in the heavens, that the detached masses of nebulæ are, in some cases, assuming, very slowly, but surely, a more and more globular and concentrated form, as though new suns and systems were in the process of formation.

On the fourth day God completely condensed the light into the focal intensity of our present sun. Then, for the first time, the Moon, and Venus, and Mars, and Jupiter, and Saturn, and all the other planets of the Solar System, which had before been invisible, on account of the feebleness of the light, flashed out into visibility as though they had for the first time been created, and commenced their diurnal and annual revolutions which have since been maintained with such perfect and undeviating regularity in accordance with those physical laws which were then established by the Almighty.

Having thus passed through with our examination of the progress of the first four days of creation and considered the effect of a gradual condensation of light into the focal intensity of our sun, we are willing

to contrast our views upon this subject with the various and conflicting opinions which appear in the quotations we have made from the British Cyclopedia. Upon our hypothesis we need not make the reply that Cyril makes to the scoffs of Julian "that Moses' view was to accommodate his story to the ignorance of the Jews; not to reason accurately on the origin of things," nor need we like Philo call it a "piece of rustic simplicity to imagine that God really employed six days in the production of things;" nor need we yet with Dr. Geddes consider "that the Mosaic account was a most beautiful *mythos* or philosophical fiction." For we think that any unprejudiced mind must conclude that upon this hypothesis the philosophy of Moses was quite as sound and rational as that of a Newton, a Locke, or any other sage that has existed or written since his day.

And now, as the earth had previously been prepared for it, and as the light had become sufficiently intense to produce vegetation, God created upon the fifth day, all the various races of beasts, birds, and fishes, which now exist upon the globe, and which, according to Geology, took the place of many of those modes of organic life which had previously existed, and which had, one after another, become extinct, as the several successive changes occurred in the progressive organization of the earth, which extinguished forms of life constituted the remainder of those fossiliferous depositions existing in the rocky stratifications of the globe not heretofore considered in our argument.

To crown the whole amazing work of creation, on the sixth day God completed his work by the creation of Man in his own image, whom he endowed with rational faculties and constituted Lord of this new and beautiful province of his universal empire.

I have carried out my argument thus far to show that Genesis may be both authentic and literal, and yet most perfectly harmonize with all the known facts of Geology, and I must here express my deep and unwavering conviction that in no other way can they possibly be so harmonized.

One thing is apparent from our investigation of this subject, which we will notice before closing. Gradual progression was the order of creation, and seems to be the established order of all God's works. He has thus shown us that he accomplishes his purposes by means, and that, in the production of every event, there is chained together a certain train of dependent antecedents and consequents. As we have seen in creation, by a certain progressive process of six days, the Almighty brought into existence that part of the material universe with which we are conversant. The spirit of God moved, as we suppose, with energizing power upon the nebulous masses of the sky. At the command of the Eternal, light was poured upon the formless "void" of the "deep." The dark, chaotic mass of material substance was separated to its appointed destination. From the basis of that mass of matter there arose, then, by degrees, into beauty, order, and magnificent vastness, this globe and her sis-

ter planets. The nether firmament was spread out between the clouds and the deep, and the buoyant atmosphere was formed to sustain the floating vapors: — visibility was given to the dry land, and the hills and valleys and landscapes were clothed with blossoms and fruits and vegetation. The sun was, on the fourth day, collected together into one mass of burning glory, and hung out like an immense ocean of fire in the vault of the sky. The moon and the stars were located around it, so as to reflect its radiance with diminished intensity. Streamlets, rivers, and oceans were filled with living substances. Flocks and herds were "scattered over a thousand hills:" and finally, to crown the whole, *Man*, the almost angelic proprietor of this uncursed, beauteous, green earth, was introduced into the fragrant groves and arbors of Eden.

LECTURE IV.

THE TRUTH OF THE NOACHIAN DELUGE PROVED BY HISTORY, ASTRONOMY, GEOLOGY AND REASON.

Our investigations have, thus far, in this series of lectures, been confined to that grand and stupendous event, the progressive and wonderful origination, by the great Omnipotent, of this Globe and its associated solar system. Assuming, at the outset, the philosophical and rational ground, that, as God is the author of nature as well as of revelation, every known fact of physical science is, therefore, of necessity, just as true, and just as worthy of credence, as every recorded fact of revalation, I undertook, by a chain of deductions from certain premises, sustained by analogical allusions and inferences, derived from physical science, to defend the truth of the latter, from the virulent assaults of scepticism, without denying any one of the well attested facts of the former, and endeavoured, as much as possible, to harmonize the two completely, as they do most assuredly harmonize *in reality*. How far I have been able to succeed in that attempt, I shall now leave to the judgment of the candid and unprejudiced reader. There is yet before me another important field of controversy. Not only have the bitter enemies of truth and advocates of sub-

tle error attempted to sneer at, and bring into ridicule the Mosaic history of the origin of the earth and the solar system, but they have entered another enclosure of consecrated ground, and entrenched themselves there, and have there opened their batteries against the authenticity of revelation, and have, from their entrenchments, hurled at the champions and defenders of truth their darts, dipped in a venom more virulent than the "poisons of asps." Into this enclosure of consecrated ground we now purpose to enter, and to dispute, with them, its occupancy, and bring to bear upon their position weapons of celestial temper, drawn from the great armory of truth, both natural and revealed, and attempt to break up the entrenchments which they imagine so impregnable, and, if possible, dislodge them from that ground, and spike the batteries in which they have trusted. This we shall attempt to do, not from any vain confidence in the power of our own arm, for, of that we are diffident. There is no strength in that, unassisted by the great fountain of all strength. But we shall do it, impelled by that unlimited confidence, which we have heretofore expressed, in the immovable stability and everlasting endurance of that eternal proposition, which is every where enstamped, in brilliant letters of fire, upon the pillars of God's throne—"*Truth is mighty and will prevail.*"

On this ground of controversy, upon which we are entering, we find marshaled, in hostile array, the same champions, who head the two great divisions of the

forces of error and opposition to truth, whom we noticed in the commencement of this series of Lectures. While the champions of one division deny, altogether, the *authenticity* of the history of the deluge, those, who head the other, with equal subtlety and strenuousness, deny its *literality*, and so both unite in the common purpose of undermining and bringing into disrepute the Mosaic narration of that wonderful event.

In opposition to their opinions and arguments, we shall assume the position, that the account of the deluge, contained in the Bible, is both *authentic* and *strictly literal*—that, in the sublime and graphic language of inspiration, "the windows of Heaven were," actually "opened, and the fountains of the great deep" were actually "broken up" — that it actually rained "forty days and forty nights"—that the deluge, actually, so prevailed over the earth, as to overflow and overtop the "highest mountains" of the earth "fifteen fathoms," and that, by the grand and awful catastrophe, and by this terrible exhibition of divine displeasure against the impurities of the antediluvian race, every form of animated existence upon the Globe was actually destroyed—actually swallowed up in the devouring vortex of the mighty flood—except those, who floated safely in the ark, over the billowy surface of the ocean enwrapped earth.

For the sake of perspicuity, I shall arrange my argument and defence of this position, under the following general heads.

1st. A general deluge is proven by the almost

universal traditionary testimony in favor of such an event, which prevails in the archives and mythological fables of all heathen and barbarous nations.

2d. There is positive proof in certain facts of astronomy, that some such remarkable event or convulsion has formerly occurred, and that too, since the organization of our Globe in its present form.

3d. There is abundant proof in Geology that some violent deluge of waters, similar to that described in the Mosaic history, has once prevailed over the whole earth.

4th. In harmony with every physical fact and law, reason unites her important testimony with science, to establish the undoubted certainty of such an event as a universal deluge.

We will here commence our argument in favor of the authenticity and literality of the scriptural history of the deluge, in the order of those propositions, which we have laid down for our guidance in this discussion.

1st. Then, a general deluge is proven by the almost universal traditionary testimony in favor of such an event, which prevails in the archives and mythological fables of all heathen and barbarous nations.

In proof of this proposition we shall take the liberty of quoting largely from the British Cyclopedia, where a large amount of traditionary and mythological testimony has been gleaned from the annals of many nations, and condensed into a limited compass.

"The account given by Moses of this catastrophe is

confirmed by the concurrent testimonies of several of the most ancient writers and nations in the world; and as the possibility of it cannot be denied, we need not recur to the hypothesis of an ingenious biblical (but eccentric and paradoxical,) critic, (see Gedde's Crit. Rem. p. 72,) who suggests, "that a good deal of the fabulous is mixed with the history of Noah's flood." Although the history of this event has been varied, and modelled according to the notions and traditions that prevailed in different countries and different ages, yet the ground-work was always established on the foundation of truth; and the event was for a long time universally commemorated. Josephus who seems to have been a person of extensive knowledge, and well acquainted with the history of nations, says, that this great occurrence was to be met with in the writings of all persons who treated of the first ages. He mentions Berosus of Chaldea, Hieronymus of Egypt, who wrote concerning the antiquities of Phœnicia; also Mnaseas, Abydenus, Melon and Nicholaus Damascenus, as writers, by whom it was recorded; and adds, that it was taken notice of by many others. From Berosus, a Chaldean by birth, who lived in the time of Alexander the great, we learn, that Chronus or Saturn appeared to Xisuthrus, the tenth or last of the Chaldean kings, in a dream, and warned him, that on the 15th of the month Desius, mankind would be destroyed by a flood; he therefore commanded him to write down the original, intermediate state, and end of all things, and bury the

writings under ground in Sippara, the City of the sun; he likewise directed him to build a ship, and go into it, with his relations, and dearest friends, having first furnished it with provisions, and taken into it fowls and four-footed creatures; and told him, that when he had provided every thing, and was asked whither he was sailing, he should answer, "to the gods, to pray for happiness to mankind." Xisuthrus accordingly built a vessel, whose length was five furlongs, and breadth two furlongs. He put on board all that he was directed to provide, and went into it with his wife, children and friends. The flood being come, and soon ceasing, Xisuthrus let out certain birds, which, finding no food or place to rest upon, returned again to the ship. After some days he sent forth the birds again, but they came back to the ship, having their feet daubed with mud; but when they were sent away the third time, they returned no more; a circumstance from which Xisuthrus understood that the earth had appeared again. He now made an opening between the planks of the ship, and seeing that it rested on a certain mountain, came out with his wife, his daughter, and his pilot; having worshiped the earth, and raised an altar, and sacrificed to the gods, he and those who went out with him, disappeared. They who were left behind in the ship, finding Xisuthrus, and the persons who accompanied him did not return, went out to seek for him, calling him aloud by his name; but Xisuthrus was no more seen by them; only a voice, issuing from the clouds,

enjoined them to be religious, declaring that Xisuthrus, on account of his piety, was gone to dwell with the gods; and that his wife, and daughter, and pilot were partakers of the same honor. It also directed them to return to Babylon, and taking the writings from Sippara, to communicate them to mankind; and finally told them, that the place where they were was the country of Armenia. Thus informed they offered sacrifices to the god, and immediately repaired to Babylon, dug up the writings at Sippara, built many cities, raised temples, and rebuilt Babylon. Abydenus also gives a similar relation. It is said that Xisuthrus or Sisithrus, Ogyges, and Deucalion, are all names signifying the same thing in other languages, as Noah does in the Hebrew, in which Moses wrote. (Vide Alexander, Polyhestor, ex Beroso, apud Syncell, P. 30, 31, et apud Cyrill, contra Julian, 1, 1, p. 8. Abydenus ex eodem, apud Syncell, p. 38, 39, et apud Euseb. de Praep. Evang. 1. ix, c. 12.) The Indians and Persians had also traditions concerning the deluge. Accordingly an eastern writer tells us, that some of those who embrace the Magian religion, are said to deny the flood, or at least the universality of it; pretending that it reached no farther than a cliff near Hulwan, a city of Irak, bordering on Curdistan. Nevertheless the orthodox among them acknowledge this general destruction by water, sent by God to punish the crimes of mankind; one of whom, named Malcus, was a monster of wickedness and impiety. One odd circumstance maintained by them is, that the

first waters of the deluge gushed out of the oven of a certain old woman, named Zala Cufa; and Mahomet has borrowed this circumstance and inserted it in his Koran; the commentators on which say, that it was the sign by which Noah knew the flood was coming. (Al Koran, cap. xi, d, Herbelot, Bib. Orient. Hyde de rel. vet. Pers. c. x.) Lord's account of the religion of the Perses, p. 9.

Plutarch (De, Solert, Anim. vii, p. 968,) mentions the Noachic dove, and its being sent out of the ark; and its going out was to Deucalion, a sign of fine weather, as its return denoted the reverse. Melo, or Melon, who wrote a treatise against the Jews (see Euseb. Praep. Evang. i. ix, c. 19,) takes notice,—among other things, of the person who survived the deluge, retreating with his sons, after the calamity, from Armenia; and he supposes that they came to the mountainous parts of Syria, instead of the plains of Shinar. This writer seems to represent the deluge as tropical, and not to have reached Armenia.

That the Egyptians were no strangers to the deluge appears, not only from several circumstances in the history of Osiris and Typhon, particularly the very day when it began, or when Osiris, (who is taken for Noah) was shut up in the Ark, and the name of Typhon, which according to some learned men, signifies a deluge or inundation; but also from the testimony of Plato, who says that a certain Egyptian priest recounted to Solon, out of their sacred books, the history of the universal flood, which happened

long before the particular inundations known by the Grecians. It is the tradition of the Egyptians, as we learn from Diodorus Siculus, lib. i, that the universal deluge was that of Deucalion. But the most particular history of the deluge, and the nearest of any to the account given by Moses, is to be found in Lucian. (De Dea Syria, vol. ii, p. 882.) He was a native of Samosata, a city of Comagene upon the Euphrates; a part of the world where the memorials of the deluge were particularly preserved, and where a reference to that history is continually to be observed in the rites and worship of the country. His knowledge was therefore obtained from the Asiatic nations, among whom he was born. He describes Noah under the name Deucalion, and says, that "the present race of mankind are different from those who first existed; for those of the antediluvian world were all destroyed. The present world is peopled from the sons of Deucalion having increased to so great a number from one person. In respect to the former brood, they were men of violence, and lawless in their dealings. They regarded not oaths, nor observed the rites of hospitality, nor showed mercy to those who sued for it; on this account they were doomed to destruction; and for this purpose there was a mighty eruption of waters from the earth, attended, with heavy showers from above, so that the rivers swelled, and the sea overflowed, till the earth was covered with a flood, and all flesh drowned. Deucalion alone was preserved to re-people the world. This mercy

was shown to him on account of his justice and piety. His preservation was effected in this manner; he put all his family, both his sons and their wives, into a vast ark, which he had provided; and he went into it himself. At the same time animals of every species, boars, horses, lions, serpents, whatever lived upon the face of the earth, followed him by pairs, all which he received into the ark, and experienced no evil from them; for there prevailed a wonderful harmony throughout, by the immediate influence of the Deity. Thus were they wafted with him, as long as the flood endured." After this he proceeds to mention, that upon the disappearing of the waters, Deucalion went forth from the ark, and raised an altar (altars according to Gen. vi, 20,) to God; but he transposes the scene to Hierapolis in Syria, where the natives pretended to have very particular memorials of the deluge. Most of the authors, who have transmitted to us these accounts, inform us at the same time, that the remains of the ark were to be seen in their days upon one of the mountains of Armenia. Abydenus says, that the people of the country used small pieces of the wood as amulets; and Berosus says the same of the asphaltus, with which it was covered, and which they scraped off.

The learned Bryant, in his "Analysis of ancient Mythology," (vol. II.) has traced out a reference to Noah and the deluge, and a resemblance of the ark, in many of the religious rites and ceremonies of ancient nations. The well known ship of Isis, among

the Egyptians, was, as he conceives, a sacred emblem; in honour of which these people celebrate an annual festival. It was, in after-times, admitted among the Romans, and set down in their calender for the month of March. The temple of Osiris (or Sesostris) at Theba was built after the model of a ship, 280 cubits in length; and both the city, said to be the most ancient in Egypt, as well as the province, was denominated from the ark, called Theba by the sacred writer. The same memorial is to be observed in other countries, where an ark, or ship, was introduced in their mysteries, and often carried about upon their festivals; and many instances of emblematical representations are cited by Bryant, which related to the history of the deluge, and the conservation of one family in the ark. This history was pretty recent, when works of this kind were executed in Egypt, and when the rites to which they belonged were first established; and this learned writer imagines, that in early times most shrines among the Mizraim were formed under the resemblance of a ship, in memory of this great event. He adds further, that both ships and temples received their names from hence; being styled by the Greeks, who borrowed largely from Egypt, *Naus* and *Naos*, and Mariners *Nautai* and *Nautae*, in reference to the patriarch, who was variously styled *Noas Naus*, and Noah. Plutarch (Isis and Osiris, vol. I, p. 366, 367,) gives us a remarkable account of Osiris being exposed in an ark. He says, that it was on account of Typhon; and that it happened on the 17th of the month Athyr, when the

sun was in Scorpio. "This in my judgment;" says Bryant, "was the precise time, when Noah entered the ark, and when the flood came; which in the Egyptian mythology was termed Typhon." From these, and many other circumstances that might be recited, it sufficiently appears, that the history of the deluge was no secret to the gentile world. They held the memory of it very sacred; and many colonies which went abroad, styled themselves Thebeans, in reference to the ark; and many cities of the name of Theba occur, not in Egypt only and Bœotia, but in Cilicia, Ionia, Attica, Phthiotis, Catonia, Syria and Italy.

The tradition of the deluge has, indeed, spread throughout the world, and is preserved in the memory of all nations; in the continent of America, as well as Asia, in the East and West Indies. among the Africans and Europeans. (See Burneti Telluris Theor. Sacra. 1, i. c. 3.)

We are told, indeed, (see Code of Gentoo Laws, Pref. p. 38,) that the Gentoo scriptures make no mention of the deluge; and that the Bramins affirm, that the deluge never took place in Hindoostan. If this be true, it may well excite astonishment, since the deluge is an event so singular in its nature, that supposing it to have happened, the memory of it could never have been extinguished amongst the generality of nations which inhabit the earth; and more especially, since learned men have abundantly proved that a tradition concerning a deluge has prevailed in every

quarter of the globe; not only amongst the Romans; Grecians, Egyptians, Babylonians, Persians, Scythians, but amongst the Iroquois, Mexicans, Brazilians, Peruvians, and other nations of America. Moreover, we are informed by one of the navigators to the Southern Hemisphere, that the inhabitants of Otaheite being asked concerning their origin, simply answered, that their supreme God a long time ago, being angry, dragged the earth through the sea, and their Island being broken off was preserved.

Now, if a tradition concerning a deluge has prevailed in almost every part of the Globe, except in India, and, as some say, in China, may we not hesitate a little till we know more of those countries, before we positively affirm, that they have no such tradition? For it deserves to be remarked, that what is said in the preface to the code of Gentoo laws, relative to the want of a tradition concerning a deluge in the Gentoo Shasters, (or Scriptures,) is contradicted by an author who lived in India, and wrote his account of the Banians about 150 years ago; for he expressly says, that he made his collections, by the help of interpreters, from the Shaster, and he has the following words:—"As if the world needed cleansing of its defilement and pollution, there came a flood, that covered all nations in the depths—and so concluded the first age of the world according to the tradition of the Banians." (Lord's Discovery of the Banian religion, c. 6.) Sir William Jones, than whom

there could not be a more competent judge, and one on whose testimony we may more securely rely, affirms, "that a tradition concerning a deluge does certainly subsist in Hindoostan," and that in the oldest mythological books there is such an account of the deluge as sufficiently corresponds with that of Moses. (See Bishop Watson's Discourse to the Clergy, &c., in his sermons and tracts, p. 220.) The learned prelate, (p. 229,) has recorded a very curious passage, quoted in the "Flora Saturnisans" of Henckel (Paris ed. 1760) from the works of Ramizini, concerning the primitive state of the earth, and the subsequent deluge, taken, as it is said, from the most ancient annals of Ethiopia."

The foregoing extracts from the British Cyclopedia, which contain a large amount of traditionary and mythological testimony respecting the deluge, gleaned from various sources, fully sustain the truth of our first proposition, and we will therefore pass on, without further comment, to the consideration of the two succeeding propositions, upon which we shall *mainly* rely to defend our position.

Before proceeding further, however, we will introduce here, from "Fairholme's Geology of Scripture," a prophecy respecting this event, contained in the Apochryphal Book of Enoch.

"In the very curious and interesting work, called the book of Enoch, referred to by St. Jude, v. 14, which had long been looked upon as lost, but which was at length discovered in the Ethiopic language by

Bruce, in Abyssinia, who brought home three manuscript copies of it, one of which was presented to the Royal Library at Paris, a second, to the Bodleian Library at Oxford, and the third, retained by himself; we find a very remarkable corroborative testimony to the above view of the subject of the deluge. In quoting from this apocryphal book, it is not necessary, in this place, to enter into the question of its actually being, what its title professes it to be, a prophetic work of the antediluvian Enoch. This point has been clearly settled by Dr. Laurence, to whom we are indebted for an English translation of the copy in the Bodleian Library. But, although, in the opinion of the learned translator, this original Hebrew, or Chaldee work, was composed subsequent to the Babylonish captivity, it must be admitted to be a very interesting and curious piece of antiquity, though not worthy of a place among the canonical books of Scripture.

"The passage I am about to quote, however, will serve to show the prevailing opinion on the subject of the deluge in the times of the author of it, and is quite consistent with the passage in St. Peter's Epistle, and with the above passage in the book of Job.

"In the 82d chapter of the book of Enoch, and the 5th verse, we find the writer prophetically describing the destruction of the 'earth, that then was,' in the following manner:

"'And falling to the earth, I saw likewise *the earth* ABSORBED BY A GREAT ABYSS, and mountains suspended over mountains, *hills were sinking upon hills*,

lofty trees were gliding off from their trunks, and were in the act of being projected, *and of* SINKING INTO THE ABYSS.

"'Being alarmed at these things, my voice faltered. I cried and said, THE EARTH IS DESTROYED! Then, my grandfather, Malaleel, raised me up, and said to me, Why dost thou thus cry out, my son? And wherefore dost thou thus lament?

"'I related to him the whole vision which I had seen. He said to me, *confirmed is that which thou hast seen*, my son:

"'And potent the vision of thy dream respecting every secret sin of the earth. ITS SUBSTANCE SHALL SINK INTO THE ABYSS, *and a great destruction take place.*

"'Now, my son, rise up; and beseech the Lord of Glory, (for thou are faithful,) that a remnant may be left upon the earth, and that he would not *wholly* destroy it. My son, all this calamity upon earth comes down from heaven, *upon earth shall there be a great destruction.*'"

2d. There is positive proof in certain facts of Astronomy, that some such remarkable event or convulsion, as a general deluge, has formerly occurred, and that, too, since the organization of our globe in its present form.

For the sake of perspecuity I shall, under this head, state several propositions, as the outlines or landmarks of the discussion, and then sustain them by a chain of reasoning, supported by appropriate analogical references and inferences drawn from them.

1st. There must, doubtless, have been a *natural* cause for the deluge.

In assuming this, we by no means disclaim, nor would we, for a moment, disclaim Omnipotent agency in the production of that great event. God works by means, but, then, the means themselves would have no power at all, did he not ENERGIZE them, and render them effectual. When He overthrew Sodom and Gomorrah and the cities of the plain, for instance, which had been for some time previously predicted, He did it by a natural cause. At the moment appointed, volcanic agency and the subtle elemental fires of the clouds effected the work of destruction. They had no power of themselves to move until He bade them. They were chained to their subterranean and rocky caverns of sulphur by a decree more binding than the "laws of the Medes and Persians, which altered not." But the moment he dissolved that decree, by his mandate, and loosened their bonds, they burst forth from their citadel, and poured the scathing thunder of their artillery upon these devoted cities.

Another instance of the agency of means employed by the Eternal, to accomplish his ends, is found in the admirable order and regularity of the solar system.—The sun is the agent, who, by the influence of the steady emanation of his light, whirls all the planets upon their axes, and bears them, with resistless energy, in their rapid circles, through the enormous circumference of their orbits, perfectly balancing, by

never changing physical law, their centripetal and centrifugal forces. But, then, the sun, after all, is only an agent, and the immutable physical law by which he wheels the planets with such perfect regularity, producing seed time and harvest, cold and heat, summer and winter, day and night, is, strictly speaking, only the sovereign and all-controling will of the Eternal. There is, therefore, no disparagement of the Almighty, in supposing that there must have been a *natural cause* for the deluge. It rather magnifies immensely, his wisdom, foresight and omnipotence to suppose that the very agent and instrument for the production of that event, had been created and prepared ages before, and only waited for the bidding of its author, to rush forth, "like a giant refreshed by slumber," to the work of awful vengeance and desolation.

2d. Whatever might have been that agent or cause, its evident *effect* was to *drag* the earth from its *former* position and change its *polarity*.

I should not *dare* thus boldly to assume this novel proposition, without I had proof *positive* to sustain me in making the assertion — proof as plain, as positive, and as immoveable as the fixed stars — proof, which will blaze from the heavens, as an everlasting and undeniable memorial of that great event, which the infidel cannot sooner gainsay or resist, than he can, with his puny lance of error, tilt against the stars, and push the twinkling lights of heaven from their brilliant thrones — proof so plain, that I am *aston-*

ished that it has been overlooked by the scientific world.

I will introduce in this connection, an important fact from Astronomy, bearing directly upon the subject at issue, which shall stand the test of scrutiny, and ward off the pigmy assaults of the sceptic, as long as the starry universe shall stand.

* "Thuban is a bright star of the 2d magnitude, eleven degrees from Asich, in a line with, and about midway between, Mizar and the southernmost guard in the Little Bear. By nutical men this is called the *Dragon's Tail*, and is considered of much importance at sea. It is otherwise celebrated as being formerly the *north polar star. About* 2,300 *years* before the Christian era, Thuban was ten times *nearer the true pole of the heavens than Cynosura now is.*"

We will first remark upon the *chronological data* of the astonishing event mentioned in the foregoing extract. It is stated that "Thuban" was the north pole star of the earth, instead of "Cynosura," the present pole star, "*about* 2,300 *years before the Christian era*,"—that is, that the earth, in its rotation upon its axis, seemed to revolve around *that* point in the heavens, where "Thuban" is located, rather than that point around which it *now* revolves, and where "Cynosura," the *present* pole star, is located, and that "Thuban" was *then* "ten times nearer" that point of revolution than "Cynosura" *now* is. About the *sources* of the information, from which Burritt

* Vide—Burritt's Geography Heavens, page 119.

drew this important fact, we shall not here remark, taking it for granted that a man of such profound research and scientific attainments, would not have introduced such a fact into his work, as *positive*, without sufficient data in testimony of its truth and reliability. This surprizing event, then, happened "about 2,300 years before the Christian era." Now this must, it will be found, by a comparison of chronological tables, have happened *at the time of the deluge*, for scholars generally compute that that catastrophe happened about 2,300 years before the same era.—They do not vary over forty or fifty years either way from that period.

Not only did this change of polarity take place at the time of the deluge, but there is another most curious and astonishing fact, bearing directly upon the question at issue, and giving the important aid of its testimony to the elucidation of the subject. It refers to the *distance* of the former pole star from the present, or, of the former point of revolution from the present.

It will be found by measurement upon the celestial map, that the present pole of the heavens is just about *twenty-three and a half degrees from* "Thuban." What does this fact show? Why, either that both "Thuban," "Cynosura," and, indeed, all the other stars of the sidereal heavens, must have moved from their former positions, or else that the earth has *been changed in its polarity* just that distance. The former certainly *cannot* have done it, for they are

fixed — *immoveably* fixed, in their several locations — the latter *must*, therefore, have been so changed. How admirably this agrees with what is denominated the "*inclination of the poles*," for it is a fact of Geography, which is familiar to every little school boy, that this inclination from a line at right angles with the plane of the ecliptic is just *twenty-three and a half degrees*.

But, as I have already exceeded the appropriate limits of a single lecture, I must break off in the midst of the discussion of this intensely interesting subject, and refer its further consideration to the next lecture.

LECTURE V.

THE TRUTH OF THE NOACHIAN DELUGE PROVED BY HISTORY, ASTRONOMY, GEOLOGY AND REASON.

Having, in our last lecture shown, by a positive and undeniable fact of Astronomy, which fact shall give its testimony to a great truth, so long as the starry heavens shall endure—that the polarity of the Globe has been *changed* since creation—that, that change must have occurred about the time of the Noachian deluge—and that the distance of that change of polarity is, by actual measurement upon the celestial map, just *twenty-three and a half degrees*, the same as the present "*inclination of the poles*" of the earth, we shall now proceed with the further consideration of this intensely interesting subject.

3d. That change of polarity, which Astronomy so clearly proves, was either gradual or else sudden.

Had it been *gradual*—had the star "Thuban," by a slow process, changed places with "Cynosura," so that its apparent movement should have been *twenty-three and a half degrees*, the phenomenon would have been so remarkable that it must, certainly, have been noticed by *some* of the ancients, who were such close observers of the stars, and who early classed them into constellations—it must have been noticed

by them, *even though so gradual* as to occupy an *age* in making the transition, and a record of the wonderful fact would have been made and handed down from generation to generation, like the "precession" of the equinoxes. But no such observation or record has ever been made or handed down—in fact no such *gradual* change of polarity ever occurred. In the language of Burritt, "as the earth performs its annual revolution around the sun, the position of its axis remains *invariably* the same; always pointing to the north pole of the heavens, and always maintaining the *same inclination to its orbit.*" The change of that polarity was not *gradual*, therefore, but, as it *actually* occurred, must, of necessary consequence, have been *sudden.*

4th. That change of polarity was either produced by an *external* or an *internal* cause.

It could not have been produced by an *internal* cause, for we cannot possibly conceive of any cause, acting *internally*, which could have suddenly turned the world around from its former position in space twenty-three and a half degrees. The earthquake might shake the globe with a terrible concussion — the volcano might burst it asunder, but we cannot conceive that either those, or any other *internal* convulsions could have been productive of such an event. The cause must, therefore, have been *external.*

5th. This cause must have been either the direct agency of the Eternal or else some appointed instru-

ment of his, prepared by his foresight, wisdom and omnipotence, expressly for the purpose.

That it was not by *direct* agency of omnipotence, we infer from the analogy of divine economy.—Throughout his immense empire, God works by the agency of *means*—by the operation of secondary causes, as we have elsewhere intimated. It certainly argues no want of efficiency and power in the Almighty, to suppose that he prepares instruments beforehand in the vast and intricate machinery of worlds and systems to execute His purposes. It must rather vastly magnify, in the estimation of all rational existences, the infinitude of that foresight, wisdom and omnipotence, which could thus prepare, in the secret counsels of eternity, instruments for the accomplishment of any given stupendous event, as, for instance, the destruction of a world, at the precise moment of its destination, and then, send it unerringly and infallibly to the swift commission of its appointed errand. The cause, then, of the change of the earth's polarity was not, we infer, the *direct* agency of the Eternal, such as turning it in space without the intervention of physical means, but an instrument expressly appointed by him for that work, and chained, until that period, by an unalterable decree, safe and harmless in the great arsenal of eternity.

6th. If the change of the earth's polarity was *sudden*, as we have already proved conclusively, the concussion, which shook it out of its previous firm and stable position, must have been *tremendous* in its en-

ergies — must have "shaken terribly the earth" — must have produced a convulsion that made nature groan to her inmost recesses, and sent terror and dismay, agitation, tumult and blank desolation throughout every department of this province of her domains.

Now what was this agent? Can we ascertain with any reasonable certainty any natural cause, which could have produced such a result? Let us examine. Comets are a very mysterious class of bodies, which are attendants upon our solar system, and, whatever may be their design, and the specific duties which they fulfil, they were certainly not created in vain.— Perhaps they were the bodies spoken of in Genesis, which were created for "*signs*." Certain it is, that the appearance of the most remarkable of them has ever inspired the nations with fear. There seems to be a sort of *instinctive* dread of them in the bosom of mankind, the same as there is of the *serpent* tribes, and, perhaps, for the self same reason — a sort of *prophetic presentiment* that they are dangerous neighbors — that they may have done us damage heretofore, in their erratic and apparently lawless wanderings, and may, one day, accomplish the destruction of the planet, in whose welfare all are so vitally interested. In the graphic language of Burritt, "when we look upwards to the clear sky of evening, and behold, among the multitudes of the heavenly bodies, one blazing with its long train of light, and rushing onward toward the centre of our system, we shrink back, as if from the presence of a supernatural being."

Let us trace one or two of these strange messengers in their course, as they make their appearance, after having wandered, for centuries, away from the sun, through the infinitude of space.

"The Comet of 1680" says Burritt, "was of the largest size, and had a tail, whose enormous length was more than *ninety-six millions of miles.*

"At its greatest distance, it is *thirteen hundred millions of millions of miles* from the sun, while at its nearest approach, it is only *five hundred and seventy-four thousand* miles from his centre or about *one hundred and thirty thousand miles* from his *surface.* In that point of its orbit, which is nearest the sun, it flies with the amazing swiftness of *one million* of miles in an hour, and the sun, as seen from it, appears 27,000 times larger than it appears to us; consequently, it is then exposed to a heat 27,000 times greater than the solar heat of the earth. This intensity of heat exceeds, several thousand times, that of red-hot iron, and indeed all the degrees of heat that we are able to produce. A simple mass of vapor, expanded to a thousandth part of such a heat, would be at once dissipated in space—a pretty strong indication that, however volatile are the elements of which comets are composed, they are, nevertheless, capable of enduring an inconceivable intensity of both heat and cold."

The nucleus of the comet of 1811, according to observation made near Boston, was 2,617 miles in diameter, corresponding nearly to the size of the moon.

The brilliancy with which it shone, was equal to one tenth of that of the moon. The envelope, or æriform covering, surrounding the nucleus, was 24,000 miles thick, about five hundred times as thick as the atmosphere which encircles the earth; making the diameter of the comet, including its envelope, 50,617 miles. It had a very luminous tail, whose greatest length was *one hundred millions of miles.*

This comet moved, in its perihelion, with an almost inconceivable velocity—fifteen hundred times greater than that of a ball bursting from the mouth of a cannon. According to Regiomontanus, the comet of 1472 moved over an area of 120° in one day. Brydone observed a comet at Palermo in 1770, which passed through 50° of a great circle in the heavens in 24 hours. Another comet, which appeared in 1759, passed over 41° in the same time. The conjecture of Dr. Hally therefore seems highly probable, that, "if a body of such a size, having any considerable density, and moving with such a velocity, were to strike our earth, it would instantly reduce it to chaos, mingling its elements in ruin."

Now have we not here, in one of these swift winged messengers, who dash through space with such terrific velocity, the *very agent* that changed the polarity of the earth? I believe we have, for there is no other known natural cause besides in the universe, which could have done it. At the precise time appointed, then, foretold to Noah, one hundred and twenty years before, one of these comets, in its light-

ning speed probably towards the sun, must have come in contact with one of the poles of the earth—by the concussion dragged it from its existing polarity—and passed along, in its terrible career, leaving our doomed planet to its fate. And what must have been the effect of such a concussion? Why just such a deluge as occurred. The land, being the more solid substance, must have been submerged beneath the yielding water by the blow, and, as "the fountains of the great deep"—terribly agitated by the convulsion—came pouring and foaming in mountain billows along over the earth, the consequence of that agitation would have been, to have filled the whole atmosphere with vapor, and caused it to rain "forty days and forty nights," until by the influx of the disturbed ocean and the out-pouring of the treasures of the surcharged clouds, the whole earth was completely buried beneath the mass of waters, just as deep as Moses described; for as much the largest space of our globe is covered with the oceans, and as they must have been forced from their beds by the concussion, there was certainly water enough to overflow the tops of the "highest mountains *fifteen cubits*." This is in accordance with the opinion of Sir David Brewster, with regard to such an event, expressed in the following extract.

"The transient effect of a comet passing near the earth, could scarcely amount to any great convulsion, (says Dr. Brewster,) but if the earth were actually to receive a shock from one of these bodies, the consequences would be awful. *A new direction would*

be given to its rotary motion, and it would revolve around a new axis. The seas, forsaking their beds, would be hurried, by their centrifugal force, to the new equatorial regions; islands and continents, the bodies of men and animals, would be covered by the universal rush of the waters to the new equator, and every vestige of human industry and genius would be destroyed."

I know that such a contingency is opposed to the computations which have been made by some eminent philosophers upon this subject. I will here quote an extract, showing their reasonings and the data upon which they build their arguments against the possibility of such a contingency, and, then, attempt to show wherein those reasonings are very fallacious, and describe the controlling agencies which they have entirely ommitted in their calculations.

"The chances against such an event, however, are so very numerous, that there is no reason to dread its occurrence. The French government, not long since, called the attention of some of her ablest mathematicians and astronomers to the solution of this problem; that is, *to determine upon mathematical principles, how many chances of collision the earth was exposed to.* After a mature examination, they reported,—"We have found that, of 281,000,000 of chances there is only *one* unfavorable,—there exists but *one* which can produce a collision between the two bodies."

"Admitting, then," say they, "for a moment, that the comets which may strike the earth with their neucleuses, would annihilate the whole human race; the danger of death to each individual, resulting from the appearance of an *unknown comet*, would be exactly equal to the risk he would run, if, in an urn there was only *one single* white ball among a total number of 281,000,000 balls, and that his condemnation to death would be the inevitable consequence of the *white ball* being produced at the first drawing."

Now these reasonings may, it is true, be philosophically correct, but, there are other agencies besides the operation of mere physical law, which must be taken into the computation to arrive at a perfectly logical conclusion. The philosopher or astronomer may speculate upon the "*chances*" or *contingencies* that certain great events in nature may or may not happen, but *theologically* considered, there is no such thing as "*chance*" or *contingency* admissible in the calculation as to the possibility or the probability of the occurrence of such events. The comets may rush in their erratic and lightning course by the orbit of our earth *nine hundred, ninety-nine thousand nine hundred and ninety-nine* times and yet be perfectly harmless, terrifying the nations in their inconceivably swift and awfully brilliant career. And why? Simply because the will of the great Omnipotent, who has formed them for *specific* purposes and every where controls their movements, chains them to that harmless career by ligatures, which they cannot break, and

to orbits from which they cannot vary the minutest iota. But, as they rush onward in their course to or from the sun the *millionth* time, they may, controlled by the self same all pervading and all powerful influence, dash right straight onward to our doomed planet, and accomplish, in the twinkling of an eye, the mighty desolation we have been considering, and yet, too, without the violation of a *single physical* law of their organization ;— for in the vast and wonderfully complicated machinery of the universe, they were destined, by their author, in the far reaching and infinite counsels of eternity, for just such a specific purpose, if formed for such a purpose *at all.* "Chance" or contingency, then, is not admissible in the calculation as to the probability of their agency in the production of any specified catastrophe — as, for instance, the destruction of a world. That single "*unfavorable* one," in the "281,000,000 of *chances*" which the French philosophers supposed, in the extract, to exist, might have been the *very one*, if we allow the theological admissibility of such a phrase, that God had ordained, when he constructed the body and established the all-controlling laws of its revolution, for the accomplishment, at the precise moment predicted, of the destruction, which we all know once occurred.

From all our arguments thus far, supported by various facts and analogical inferences, drawn from the physical sciences, we infer that the change of polarity, which the earth has undergone since creation, and

the occurrence of which took place, as Astronomy proves, "about 2300 years before the christian era, must have been produced by a comet, as it dashed by our planet, and, that change of polarity, occurring *suddenly*, as it did, must, of necessity, have produced the deluge and all its wondrous and startling phenomena.

There is something very appropriate and to the point, in the language of the extract which we made in our last lecture from the Apocryphal book of Enoch, the "seventh" antediluvian patriarch from Adam, which contains a remarkable prophecy respecting the destruction of the world by a deluge, and, which, as its divine inspiration was recognized by the Apostle Jude, is valid scriptural authority in the case. In the vision there recorded, the earth is represented as "SINKING INTO THE ABYSS" OR DEEP. Now this is just such an effect, as we have supposed to be produced by the blow or concussion which changed the polarity of the earth. Such a blow must, as we have said, have submerged the Globe in the waters of the "abyss" and given the appearance of "sinking."

Taking it for granted, now, that we have thus far, satisfactorily proven, what we have *attempted* to prove, we will proceed with our other proposition to account for other phenomena connected with this subject.

6th. The poles of the earth, before the deluge, must have been at *right angles* exactly with the *plane of the ecliptic*, since the distance from "Cynosura" to the star "Thuban" in the constellation

Draco, being the distance which it was dragged from its former polarity, is about twenty three and a half degrees, that being, also, exactly the present *inclination of the poles.*

There is in this remarkable fact, a natural and definite cause for the longevity of the antediluvian race. If the poles of the globe were, as they must have doubtless been, at *right angles* with the *plane of the ecliptic*, then there could have been no change of seasons from intense heat to intense cold, as there is now, as any scholar will see at a glance, for the sun would always have been at the equinox, or over "the equinoctial line," as it is called, and there would, therefore, have always been equal day and equal night the world over. This would, as every one must see, have produced such an equability, mildness and balminess of temperature, as we, in the present condition of things know nothing about; for it is evident that the great and sudden variations of temperature, from heat to cold and from cold to heat, producing storms, tempests and hurricanes, which pervade this planet, are owing mainly, if not *entirely*, to the inclination of the poles, and we know not but that the first awful storm, which beseiged the condemned earth, might have occurred at its sudden change of polarity.

Owing to this equable and balmy temperature, many of the most prominent causes, which *now* produce disease in its ten thousand various forms, excruciating torture and sudden death, which make such furious onsets upon this "poor terrestrial citadel of

man," human life must have been much longer than it is at present, and man was then young when he was an hundred years old, in the vigor and prime of manhood, when he was three or four hundred years old, and *aged* only when he had attained the remarkable longevity of some eight or nine hundred years.

Just as soon, however, as the deluge subsided, and the population of the earth began to be multiplied, human life was very essentially shortened, caused undoubtedly, in a great measure, by the sudden and extreme variations of temperature, owing to the present inclination of the poles, and the consequent change of the seasons; for it is an established fact, that such variations are productive of disease in its every variety to an alarming extent, so that a person is now in the prime of manhood at thirty-five or forty and very old at seventy.

One generation, which now constitutes the average life of man, is computed to be but thirty years, and the immense mortality, consequent upon this fact, is a standing memorial of God's displeasure against sin, and of the awful cause which produced the deluge.

This leads to a train of most melancholy thought. It is computed that there exists upon the earth at any one period about *one thousand millions* of inhabitants. Now, if *thirty* years constitute one generation or the average life of man, then this whole vast army of *one thousand millions* speeds its rapid march into the land of silence and darkness, during every successive period of thirty years. This is at the rate of *thirty-*

three millions three hundred and thirty-three thousand three hundred and thirty-three in a *single* year, over *ninety-one thousand three hundred and thirty-four* in a day, *three thousand eight hundred and five* in an hour, *sixty-three* in a minute, and over an average of *one* every second of time—every *tick of the clock!* How startling the thought that mankind are hastening into eternity with such a *hurricane rush!* How humbling to the pride and pomp of a vain glorious world!

We now come to the consideration of the next general proposition, which we laid down for the guidance of this discussion, in our first lecture upon the deluge, and shall for the want of time, bestow upon it but a passing glance, considering, as we do, that our positions are abundantly established by the arguments under the head of the previous proposition.

3d. There is abundant proof in Geology, that some violent deluge of waters, similar to that described in the Mosaic history, has once prevailed over the whole earth.

To sustain this proposition, I will here quote from the testimony of Hitchcock's Geology, showing that there must have been a mighty and violent flood of waters at some remote period, which formed the upper strata of the earth, which is called diluvium or drift.

"Drift is distinguished from alluvial deposits: 1st. By its occurrence in situations where no agency at present in action could have produced it. 2. By

requiring, if not a different agency from any now in operation to produce drift, at least a greater intensity of action. 3. By the evidence of a great difference of climate between the two periods.

In the disposition of drift, we find the evidence of two distinct phases of action, which may, however, have been the result of the same general cause, operating in different circumstances. In the first case, the drift has been carried outward from the summits and axes of particular mountains, and spread over the neighboring plains.

In the second case, the agency by which drift has been dispersed, has operated on a more extended scale, and driven in a southerly direction over all the northern hemisphere, often to a great distance.

To begin with the American continent at the northeasterly point where observations to be depended upon have been made, we find that the bowlders, spread over the southern part of Nova Scotia, were derived, according to Sir Alexander Coke and Messrs. Jackson and Alger, from the ledges in the northern part of the province. Through the whole extent of Maine, the evidence is very striking of the southerly transport of the drift, the course being usually a few degrees east of south. And transported bowlders are even found towards the summit of Mount Katahdn, which is 5300 feet high.

In Massachusetts, the direction, taken by the drifts, as shown by a multitude of examples, varied from north and south to northwest and southwest; the most

usual course being a few degrees east of south. This course carried the current very obliquely across most of the precipitous ridges of mountains in the State; nevertheless, the bowlders held on in the general direction with remarkable uniformity. The largest blocks usually lie nearest to the bed from which they were derived, and they continue to decrease in size and quantity, in a southeasterly direction, for the distance of several miles; sometimes as many as 50 or 60; and not unfrequently even 100 miles, though usually the sea coast is reached short of that distance. But often bowlders from the continent are common upon the islands many miles distant from the coast; as on Nantucket, Martha's Vineyard, and Long Island. In the western part of Massachusetts, the mountains are from 1000 to 3000 feet high; yet vast quantities of bowlders have been carried over their precipitous ridges, and both slopes are covered with them; the largest being upon the northern side.

On Long Island the drift corresponds to the rocks on the continent; those of different kinds, always lying *south* of the ledges from which they were derived. In the eastern part of New York, the course was southeasterly; as in the western part of Massachusetts. But towards the western part of the State, its general course appears sometimes to have been west of south. In the southeasterly part of the State, bordering on Pennsylvania and New Jersey, its direction varied from south several degrees west to southeast: and near the city of N. York, the course was N. W. and S. E. In

the fossiliferous region of western New York, and in the States south of the western lakes, great numbers of bowlders of primitive rocks are strewed over the surface, significantly called *lost rocks*. These have been satisfactorily traced to the beds from which they were derived in the west part of Michigan and on the north side of the lakes in Upper Canada. Similar evidence of a southeasterly drift exists in Virginia. According to Dr. Drake, primitive pebbles occur on the right bank of the Mississippi as far south as Natchez.

The distance to which bowlders have been carried southeasterly from their native beds in our country, has not been very satisfactorily determined. In New England, they have been traced rarely more than 100 to 200 miles. But in the western States they are strewed over a greater distance. I am informed by the gentleman engaged in the geological survey of of those States, that primary bowlders are rarely found south of the river Ohio; but they are strewed over almost every part of Ohio and Michigan. Now the primary rocks from which they have been derived, are found on the north side of the great lakes. This would make their longest transit between 400 and 600 miles.

On the western continent the evidences of a southerly direction of the force seems to be decided; although from some of the highest mountains it was outward from the axes. In Great Britain the general course was a little east of south, modified, however, and sometimes very much changed, by the shape of

the mountains; some of which, as the Penine chain, appear not to have been passed over by the bowlders, except at their lowest points. In the east part of England, the drift appears to have been derived from Scotland, and also from Norway. On the continent of Europe, the Netherlands, Denmark, the plains of the north of Germany, of Poland and Russia, are strewed over with bowlders and pebbles, which can be traced to the parent rocks in Sweden, Lapland and Finland; in which countries they are yet more numerous upon the surface. In most cases these bowlders must have crossed the Baltic. In Sweden the current appears to have set S. S. W. The blocks decrease in size on going south, and finally at a great distance (more than 400 miles) they disappear. An interesting example of the dispersion of bowlders in a southerly direction in Northern Syria, is given by Mr. Beadle, American Missionary in that country. On the coast 60 or 70 miles north of Beyroot, he "reached a volcanic region with a remarkable locality of greenstone. The pebbles from this locality are scattered the whole distance to Beyroot. At that place they are quite small, but gradually increase in size as you advance to the north, and terminate entirely in this locality." This is an important fact; because it proves the occurrence of glacio-aqueous action, on the Asiatic continent much farther south (about 32° N. lat.) than had been before pointed out; unless it be upon the Himalayah mountains.

According to Mr. Darwin, the equatorial regions of

South America exhibit but few marks of glacio-aqueous action, or rather they are destitute of bowlders. But beyond 41° south latitude, they appear in Chili and Patagonia. Hence some geologists infer that the phenomena of drift are limited to the colder regions of the globe. But De La Beche describes drift as abundant in Jamaica, in the West Indies; especially on the plain around Kingston; and says that it appears to have been brought from the north. A similar statement was made to me by the late Prof. Hovey, who resided two years in the West Indies. Prof. Struder states that in the hill country at the foot of the Himalayah Mountains in India, erratic bowlders occur. We have also seen above, that similar phenomena occur in Africa, near Mount Atlas, in N. latitude about 32°. Mr. Darwin, however, attempts to explain such cases, and very probably he is correct; though it is possible that high mountains, even within the tropics, may have been subject to glacio-aqueous agency, though no marks of it appear upon the surface generally. More recently, Sir Robert Schomberg has described enormous, far transported bowlders in British Guiana.

I have quoted the above remarks of Prof. Hitchcock, not because I agree exactly with that eminent scholar in all his opinions and inferences; but because the *facts*, which he states, are very important. In common with others, he refers many of the phenomena of the drift to glacio-aqueous action, but I believe the whole phenomena can be referred to an entirely

different agency. If it was the effect of glacio-aqueous action, is it reasonable or probable that such drift would have occurred in the equatorial regions?

It will be observed from the facts we have quoted, that there was a current, when the drift was deposited, of tremendous force from the north to the south. This was its general course on both continents, and it prevailed over the whole earth, turned aside occasionally somewhat from the *general* course, by the obstruction of intervening mountains, and showing an agency less and less intense as you approach the southern end of those continents. We cannot, now, it seems to me, adopt the hypothesis, with any show of reasonableness, that a general glacio-aqueous agency has thus swept over both continents, and over the equatorial as well as polar regions, with force enough to produce all the phenomena of the drift. To what agency, then, shall we refer the production of all those phenomena? To the deluge, I think. And could *that* have produced them? If the deluge was caused by the terrible concussion of a passing comet, and the land was situated then mostly in the *southern* portion, while the oceans occupied the *northern* portion, we can readily conceive what must have been the result, had that comet struck the southern pole, dashing on as some of them do, at the rate of *one hundred millions* of miles in an hour. It would have driven the land of the south pole against the yielding water of the north pole. And what would have been the inevitable consequence? Why plainly to have brought

the waters of those oceans with an irresistible rush *southwardly* "over the continents, in the very course of the drift, sweeping before it immense rocks and bowlders, torn from the tops of the mountains that resisted its tremendous avalanches of water—avalanches produced by a concussion, of the force of which the boldest stretch of the imagination can hardly form an adequate conception. Does any one doubt that such an event could have produced such results? There is a striking illustration to the point, though upon a scale of power far more *diminutive*, which, doubtless, once occurred in the valley of the Connecticut river. There is every appearance that Mount Tom and Mount Holyoke, near Northampton, Masschusetts, were once united, and formed the barrier of a large lake, which flowed above them; for, into the upper side, five or six hundred feet above the base of Holyoke, the rocks are water worn all along the range, at the probable surface of the lake, in some places *eight or ten feet.* In the process of time, that lake broke through its rocky barrier, split the mountain in twain, cutting its way down to the present bed of the river some seven or eight hundred feet from the summit, leaving Mount Tom on the one side and Mount Holyoke on the other, turning rocks out of their original bed that would weigh thousands of tons, and sweeping the principal mass five miles south, and forming the falls of South Hadley. Professor Silliman, who has examined the mountain pass, takes the same view of the subject. Now if a lake of that

size, with no uncommon extraneous cause to have produced an increased pressure, could have torn its way thus through the solid rocks of a mountain and swept the mass down from five to ten miles below, is there any improbability in the supposition, that, when the mighty oceans, aided by a tremendous extraneous concussion, came thundering with their mountain billows along over the land, all the phenomena, presented by the drift, should have been produced? I conceive not, for the force of the resisting water of the ocean, under such circumstances must have been inconceivably greater than that of the lake, leaving its deposits of drift on the southern side of the hills and mountains as it passed along.

As we should naturally suppose, if such a catastrophe happened, as we have inferred, the land would have emerged from the water, when it rose above it, at the *north* pole or in the *northern hemisphere*, where the main body of it actually now is, while the waters, forced over by the concussion, would have remained more in the *southern* hemisphere which is actually now the case.

From important discoveries in the geological stratifications of the globe, there is further testimony that the earth has not only been changed in its polarity, by some terrible concussion, sufficiently powerful to do it, but that it has thus been shoved through the yielding waters of the ocean, from the *south* to the *north*. We infer this from the fact that the organic remains, both of animals and vegetables, found in the drift, as well as in the lower stratifica-

tions of the northern and friged zones, indicate that those zones were once located at or near the equator.

Auricarias, the living species of which exist only in tropical climates, are found in a fossil state in Great Britain alone, while the elephant is found in the fosiliferous stratifications in the *northern* parts of Europe Asia and America. In the frozen mud and gravel of Siberia are also embedded the rhinoceros and elephant, natives of the torid zone, as if they were suddenly surprised and overwhelmed by some torrent in the region of their proper locality. I might multiply thousands of specimens both in the drift and in the lower fossiliferous stratifications, which would go to prove, that the former equatorial regions must, by some gigantic and resistless force, have been pushed northward; but those which I have noticed must suffice. A *few* well selected and incontrovertable facts are as conclusive as a *million*. And now we come to the consideration of our closing general proposition.

4th. In harmony with every physical fact and law, *reason* unites her important testimony, with science, to establish the undoubted certainty of such an event, as a universal deluge. And what is that testimony, so important? Why, it is simply this. Any event, recorded as having happened in ages past, and proven by such an abundant array of testimony, drawn from the three sources of History, Astronomy and Geology, as we have drawn, must be true,—must certainly have occurred. Any one, who would doubt it, would almost doubt the very evidence of his own senses.

Any one, who would "*allegorize*" away the great fact, so to speak, into whimsical and insane notions and mysticisms like those of Swedenborg, would "*allegorize*" away the fixed stars, which stand as an enduring memorial of its truth; and, with an unmeaning jargon of words, or subtle sophistries, would prove that those twinkling luminaries do not exist in *reality*, but are only a vast congeries of *splendid deceptions*. Any one, who would not believe the mass of testimony, which has been brought to prove the occurrence of a universal deluge from so many varied sources—from every point of the compass,—has shut his mind, with inflexible obstinacy, and is determined not to be convinced, even though the evidence, against such unreasonable scepticism, should be as brilliant as the sun at noonday. Let such an one, however, know for his consolation, that he might, with just as much reason, expect, that, with one wave of his hand, he could sweep the constellations from the vault of the sky and blot the stars all out of heaven, as to expect, by the puny array of the resources of his purblind intellect, or the pompous display of his rush light reason, to invalidate, undermine or bring into disrepute a single evidence of the authenticity of divine revelation; for, let him know, that the great proposition—"*Truth is mighty and will prevail*"—stands against the assaults of his puerile, impotent and impious objections, like a rock in the centre of the ocean;—yea and will *continue* to stand, when his palsied arm shall be powerless in death, or his brazen

brow of impiousness, which has been unblushingly lifted up against heaven, shall be scathed and scarred by the unerring bolts of the Thunderer, who sent the awful desolations of that deluge over the earth, as a punishment for the rank impiety and infidelity of the antediluvian race.

Having, thus far, considered two important epochs in the history of the past, the creation of our earth and its desolation by a deluge, which extinguished all the animated forms of existence from its surface, except those which were saved in the ark to re-people it again, we will now, in closing this Lecture, turn our attention, for a moment, to two events in the future, which will, if possible, be more awfully interesting;—and taking it for granted that there is no need of further argument in favor of the anthenticity of the Bible, we shall derive our information with regard to these two events from this source.

1st. There is a day coming, known only in the deep counsels of eternity, when this system shall again be reduced to its original elements by a conflagration. It is predicted in the following sublime description. Isaiah says—"The heavens shall be rolled together as a scroll, and all their hosts shall fall down, as the leaf falleth off from the vine and as the falling fig from the fig tree." St. Peter says—"the heavens shall pass away with a great noise and the elements shall melt with fervent heat, the earth also and the works that are therein shall be burned up," and again he says in another place—"the heavens being on

fire shall be dissolved and the elements shall melt with fervent heat." Doubtless this wonderful event shall present the same grand spectacle to astronomers of other worlds, if such there are, that the burning star did in 1572 to Tycho Brahe—a conflagration, that shall not only completely vaporize our earth, but, indeed, the whole system, reducing it to its original condition. Dr. Young in his Night Thoughts thus graphically describes the event.

At the destined hour,
By the loud trumpet summoned to the charge,
See all the formidable sons of fire,
Eruptions, earthquakes, comets, lightnings, play
Their various engines; all at once disgorge
Their blazing magazines, and take, by storm,
This poor terrestrial citadel of man.
Amazing period! when each mountain's height
Outburns Vesuvius; rocks eternal pour
Their melted mass, as rivers once they pour'd;
Stars rush, and final ruin fiercely drives
Her ploughshare o'er creation!
* * * * * * *
At midnight, when mankind is wrapt in peace,
And worldly fancy feeds on golden dreams,
To give more dread to man's most dreadful hour;
At midnight, 'tis presumed, this pomp will burst
From tenfold darkness, sudden as the spark
From smitten steel; from nitrous grain the blaze,
Man, starting from his couch, shall sleep no more!
The day is broke, which never more shall close!
Above, around, beneath, amazement all!
Terror and glory joined in their extremes!
Our God in grandeur, and our world on fire!

Out of the resulting elements, the earth shall be reformed again. St. Peter says—"there shall be a new heaven and a new earth." The Revelator says: "I saw a new heavens and a new earth, for the first heavens and the first earth were passed away." So then, Omnipotence will again reform it after its destruction. But it will be organized very different from what it

is at present. According to St. John there will be "no more sea"—"no night"—nor "light of the sun," for "the throne of God" shall be transferred to it; and he shall be "its light." Yes, it will, as it were, be the future palace of the "King Eternal"—perhaps be one immense planet, formed out of the chaotic materials of Jupiter, Saturn, Herschel, and the other planets of our system commingled with the elements of our globe—be the great central orb to the "new heavens," and be furnished for the blissful and everlasting residence of the sanctified and saved.

LECTURE VI.

REMARKS UPON THE ESSENTIAL PRINCIPLES OF CREATION, AND THE ORGANIC LAWS OF THE WONDERFUL AGENT OF ELECTRICITY EXPLAINED AND ILLUSTRATED.

As our attention has hitherto, in the five previous lectures of this series, been confined to the organization of this globe and its elements, and, as, in the four lectures which are to succeed this, we shall minutely investigate the essential properties and qualities of Light and certain other imponderable principles identical with it, it is appropriate and, indeed, necessary, for a full understanding of the subjects discussed, to introduce here an intermediate or connecting link between the previous lectures and those which are to follow, by an examination of what may be denominated the essential principles of creation, and an illustration of the organic laws and peculiar operations of the wonderderful agent of electricity. This I cannot better do, than by stating as the basis of our argument, the following broad and comprehensive proposition:

There are, of the productions of creative power, three distinct essences, or essential principles in the universe, and BUT *three, and every thing created and finite, of which we either have or can have any conception, whether it be animate or inanimate — physi-*

cal, animal or intellectual, can be referred to one or the other of these three essential principles, as to its native, legitimate, proper basis or substratum.

This proposition, it will be seen, embraces within its comprehensive scope the whole illimitable domain of science, both visible and invisible. Sceptics in the republic of letters, or old fashioned book-worms, who regard the slightest encroachment on what they may have read, as sacrilege, will doubtless call this proposition sweeping and chimerical. But sweeping and chimerical, as it may, however, seem to them or others, it is believed, nevertheless, to be capable of satisfactory and even perfectly conclusive and logical demonstration, as will be shown hereafter.

The names of those three fundamental principles we will here give in their natural order, together with a concise definition of their properties.

The first we shall call *Ponderable Matter*, it being the same technical epithet, which is used in standard works. By this term we include all those substances of every name and form, which are tangible — which can be noticed or appreciated by most of the senses by which we acquire ideas of external objects — which are measurable, and which have magnitude and weight.

The properties or qualities of this first essential principle of the created unverse we consider to be perfect inertness and inherent dormancy, meaning by those terms, that a substance under their influence has no activity or disposition to activity in itself — that it has therefore no power of changing itself, or of commu-

nicating motion to iself, either by component parts, or in the aggregate or whole — that it would, therefore, remain forever changeless, as when left at creation, and forever unvaried by modification, a cold, motionless mass of inertia or sluggishness, unless operated upon by foreign agencies, sufficiently powerful to overcome that inherent disposition to remain forever sluggish and unmoved.

The second essential principle embraced in our proposition we shall call *Imponderable Matter*, it being, also, the same technical epithet by which it is designated in the text books. By this term I include Electricity, Galvanism, Magnetism, Light, Heat or Caloric, Gravitation, the Attraction of Cohesion, Capillary Attraction and Chemical Attraction. These are all, in their nature, alike intangible. That is they cannot be handled so as to be examined like ponderable substances of the first class. They are inappreciable by most of the senses; immesurable, and have no perceptible magnitude or weight.

This *imponderable principle* is entirely distinct and different from ponderable matter, not derivable from it, but perfectly independent of it, and yet having such a natural affinity for it, by the inscrutable attraction of opposites, which seems to be an immutable law of nature, as to pervade it completely. Not a single particle of ponderable matter is there in creation — not an atom borne on the atmosphere — not a single mote floating in the sunbeam, but what is

attended by its appropriate share of the imponderable principle, when all the elements are in equilibrium.

This wonderful and mysterious agent is extremely subtle — so subtle that it is invisible and imperceptible, except when condensed into the electric spark, or accumulated by the galvanic battery, or poured down upon us in the light of day, or gathered into focal intensity by the lens or burning glass, or exploded in the thunderbolt of the clouds, or collected together into that capacious reservoir of electric fire — *the Sun*. Elasticity unbounded is one of its characteristics and its activity is inherent and more restless than the ocean wave, it being always in motion; for, if the balance of the elements be disturbed at all, and there be, any where in creation, a partial vacuum, or an abstraction of the subtle fluid, so far as to make that spot *minus* with regard to surrounding regions, it rushes in with irresistible velocity, and restores that disturbed balance. Rapidity inconceivable characterizes its movements. If impeded in the slightest degree in its everlasting career, and accumulated and restrained by appropriate exciting causes, it exhibits a fearful energy — an energy perfectly overwhelming, and bursts its bands with infinitely greater ease than did the unshorn Sampson.

It is that agent, independent of ponderable matter, at which we have already hinted, which pervades it omnipresently, according to certain definite laws, having a natural affinity for it, and possessing inherent power sufficient to overcome its inertia or sluggishness,

to work all the chemical changes and produce all the motions in it, whether on the scale of atoms or of worlds or of constellations of worlds. It, in fact, seems to be the very representative of Deity himself, expressly appointed and commissioned to produce the multiform and almost countless transformations of matter — all the chemical changes of decomposition and re-composition, which are constantly progressing around us and throughout nature, and, by its inherent energy, and the activity which it imparts, to keep up the motions of the universe of material systems, and to invigorate both the animal and vegetable life, in its myriad forms, with which those systems are furnished.

Some materialist may here draw the confident conclusion from what I have asserted, that imponderable matter is *mind*, and that it is the *only Deity in the universe.* No such conclusion, however, results necessarily from the premises. Instead of favoring the doctrine of materialism in the slightest degree, I pledge myself to be prepared to show, whenever necessary, that, from *this source*, alone, can be drawn the most powerful and convincing arguments which can possibly be drawn from nature to overthrow that doctrine. I am not one of those, who tremble to acknowledge an undeniable fact, lest that fact should seem, forsooth, to militate against my creed. The God of nature never could have created an agent, or have established a law, which, when *discovered* and fully *understood*, would militate against his divinity, or undeify himself in the estimation of a *sound philosopher.*

We must never deny the evidence of our senses, and discredit incontrovertible facts, lest, peradventure our *belief* should be overthrown by them, but should endeavor, by ingenuous and candid investigation, to ascertain *how they can be reconciled with our belief.*

We now come, naturally, to the *third* essential principle of the created universe, which we denominate *mind.* *Pure etheriality* seems to be its constituent property, which term, we think, will correctly define its nature, if, in the acknowledged vagueness, looseness and imperfection of language, all shall attach to it an appropriate signification. The intellect is no more a substance, or the emanation of a substance, than thought or a train of thought is substance. As the emanations and exhalations, or the minute particles flying off from matter are matter *also*, so mind is, and, of necessity, *must* be, in the inherent fitness of things, of the same nature of its exhalations, which we know are *thought, intelligence, moral feeling and volition,* properties which may be truly said to be *something*, or *realities*, though there be no *materiality* about them. Who, for instance, would affirm that an *idea* is matter? Has it length, breadth and thickness, either perceptible or imperceptible, as have all the particles of matter, either ponderable or imponderable, how minute soever they may be? To attempt seriously to disprove such a proposition would be too much like battling, with Quixotic valiancy, the unsubstantial shadows which chase each other over the landscape. Such an attempt would sufficiently

establish a man's claim to the diploma of a confirmed Bedlamite, and would entitle him, beyond all controversy, to a strait jacket, and an introduction to the benevolent hospitalities of a mad house. Such a proposition is too preposterously absurd for a single moment's belief. The influence which the intellect, or its controling power, the will, exerts over the other two fundamental principles of creation entirely precludes such a belief. For, as the imponderable principle controls the ponderable, so *mind* controls both the *one* and the *other*.

The intellect or will of the carpenter, for instance, controls the muscles of his physical frame, through the action of the nervous fluid or animal electricity upon those muscles, and, by the strength and motions of his physical frame, so controlled, the edifice is constructed, and the grand, the beautiful and the symmetrical in architecture are made to adorn the dome, the temple, and the various other fabrications of the mechanic arts.

The imponderable principle is, also, subject directly to the volition of intellect, although it has no guiding will of its own.

A Franklin, for instance, could extract the subtle fires from the storm-cloud, as it passed overhead, with his electrical kite, and conduct the red and crashing bolt, harmless to the earth by his lightning rod.

Galvani and his successors could extract the same fiery fluid from a certain association of zinc, copper

and the acids, in a stream strong enough to burn iron like tinder.

There is, in the universe, still another Principle — if it be right to call the same a principle — whom I have not included in my classification, because he comes not within the list of created substances. His attributes are Omniscience, Omnipresence, Omnipotence, and Eternity, as they must, of necessity be, in the very inherent nature and fitness of things, if uncreated or self-existent, for an uncreated agent could not possibly be otherwise than infinite.

This self-existent, eternal principle we call Deity. Beyond Him we hold that there can be nothing either created or uncreated, finite or infinite. He embraces and controls and pervades and governs everything.— As electricity governs inert matter, and created mind governs both, in a certain sense, so this fourth mysterious, incomprehensible, all pervading Essence gives immutable, irresistible laws to the whole three in an *unlimited* sense, and does precisely what He *wills* throughout the whole *illimitable* vastness of both *duration* and *space.*

Having thus stated what I consider to be the three essential created principles of the universe, I shall now particularly examine the organic laws and peculiar relations of one of them.

Electricity was first detected or discovered in a substance called, in English, amber, which substance in the original Greek was called *electron* from which the term *electricity* is derived. This word *electron* is al-

so derived from *electore*, another Greek word, which signifies *the beaming Sun*, and, if it does not indicate that the ancients supposed the Sun to be the fountain of this subtle fluid, it at least developes a remarkable accidental coincidence.

Thales, a celebrated Grecian of the city of Miletus in Ionia, who lived 600 years before the Christian era, and who was the contemporary of Pythagoras, is reputed to be the discoverer of this remarkable property of amber. He ascertained, probably by accident, that when rubbed, it acquired the power of attracting to itself certain light bodies in its immediate vicinity. For the want of amber, the student can illustrate the phenomenon with a stick of sealing wax.

Familiarity with facts should never be suffered to lessen their interest, nor should we overlook the simplest truths, for, a thorough knowledge of those simplest truths, often leads to the discovery of the grandest and most sublime; while he that despises the "day of small things," will, probably, never live to see the day of large things. The most magnificent results often thus originate. The dim dawning of the morning precedes the blaze of the meridian. The diminutive acorn springs up and becomes an oak, monarch of the forest. The majestic Amazon first issues as a little rill on the eastern declivity of the Andes. A neglected spark kindles a conflagration and millions of wealth are lost in ashes. So with a thousand other facts. Their origin is simple but their results are grand.

As the sealing wax before being rubbed is passed over little bits of paper prepared for the purpose, they are perfectly quiescent. Both are in a state of natural equilibrium or balance. Having excited it however, by friction, it immediately exhibits a singular power unknown to it before. In this little experiment, trifling and simple as it may appear, there are treasured up volumes of wonder and inscrutable mystery, enough to puzzle for ages, the clear sighted penetration of a Newton himself. What is it that first diffuses over those bits of paper, a tremulous quiver, then sets them upright as if alive, and then makes them leap up, as if either in affection or in anger, to the cause of their momentary animation? Echo only answers—"what is it?" The chemist is puzzled and silent, the books answer not, and no one can tell. The influence of the charmed sealing wax over those bits of paper is beyond the comprehension of the most gigantic intellect. All that can be known is that it is *Electricity*, and that its operations are guided by certain fixed and immutable laws.

No wonder Thales stood in astonishment, when he made the discovery. No wonder he thought the amber animated with a principle of vitality. The emotions of the mind, when a grand fundamental or elementary truth first breaks upon it, are unutterable, and cannot be apprehended by the dull phlegmatic, who always plods along in the beaten path of his grandfathers. Such emotions often find vent in exclamations, similar to those of Archimedes in Greek,

when he had discovered the solution of a difficult problem, upon which he had been long and intensely studying. In ecstacy he exclaimed—"*eureka—eureka*"—"*I have found it—I have found it.*"

From the time of Thales to that of Theophrastus, a disciple of Aristotle, who lived between two and three centuries after him, no new discoveries were made in electricity, which is somewhat surprising, since it is no local or occasional agent, but coeval with time, pervading all substances omnipresently, and being the palpable cause of some of the grandest scenes in nature.

In the work of Theophrastus, entitled in Greek, "*Peri Lithone*," he ascribes the same property, which Thales discovered in *electron*, to the lapis lyncurius, the substance now called tourmaline. "It possesses," says he, "an attractive power, like amber, and, as they say, attracts not only straws and leaves, but copper also and iron, if in small particles."

From the period of Theophrastus, no allusion is made by authors, for more than two thousand years, to any but the discoveries already noticed, and, therefore more than twenty three centuries elapsed from the observations of Thales, before any material addition was made to the stock of electrical knowledge. Since that, for the last two centuries, its accumulations have been vastly more rapid and increasingly important.

Amber and a great variety of other substances are capable of exhibiting electrical phenomena. Friction

is, generally speaking, the cause of the exhibition of such phenomena. When they are made by friction to exhibit those appearances, they are said to be electrified or electrically excited, and the power of attraction, which they then exhibit over contiguous light bodies is denominated electrical attraction.

But this is not the only power manifested, or the only influence exerted, by this agent, over bodies or in conjunction with their own properties. There is a *repulsive* as well as an *attractive* force. This attraction and repulsion, depend, as will be seen, upon the different electrical states of different bodies.

For illustration, rub a glass tube. It becomes electrically excited. Hold it over little bits of paper. They are attracted towards it from some distance, and with considerable force. But you perceive that the moment they come in contact, they receive a portion of the electricity, which attracted them and are immediately repelled. Dropping, however, upon some other substance, they impart to that substance a portion of the electricity, which they received from the glass and are again attracted towards it, though with less force than before, because it is less excited than before, having in the first contact lost a portion of its superabundant electricity. This alternate attraction and repulsion continues, though more and more feebly, until the excited substance has lost entirely its electric charge, and has returned to its natural state. It then exhibits no attractive powers whatever. Contiguous light bodies, however light and easy moved, re-

main perfectly unaffected and quiescent at its approach.

Another piece of apparatus, by which attraction and repulsion are still more forcibly and amusingly illustrated, is what is called the apparatus for the dancing figures, by which, pieces of paper, or images cut from paste board, or the pith of elder, are made to dance between two plates, by the action and reaction of positive and negative electricities.

How wonderful the agency here exhibited? Who does not look with astonishment upon the mock creative and life giving energy, which electricity displays. Had some chemist made an exhibition like this in the dark ages, without explanation, or even in the days of Salem witchcraft, it would have rung throughout the country, that he had made a league with the evil one, and he would, as a compensation for his wisdom and wit, have stood a pretty good chance to get a roasting for a wizzard. There is a case on record, directly in point. John Faust, an ingenious German, by the invention of types, was enabled, during the dark ages, not only to publish books much faster, but also much *cheaper* than before. This newly discovered art he kept secret for a time, and hence originated the nursery legend of *Dr. Faustus and the devil*, in which he is represented as calling to his aid unlawfully the spirit of darkness.

Our observations thus far, have been the means of ascertaining these three facts:

1st. *Bodies electrically excited attract bodies unexcited.*

2d. *Two bodies electrically excited, as when one excited body has imparted a portion of its electricity to an unexcited body, mutually repel each other.* And,

3d. *Two in their natural state have no perceptible influence upon each other, but are perfectly quiescent.*

It follows, then, as a matter of course, that these three facts lay the foundation for three distinct propositions.

1st. *Opposite electrical states attract.*

2d. *Similar electrical states repel.* And,

3d. *When bodies are in their natural state, they are in a perfect equilibrium or a balance, exerting neither an attractive nor a repulsive influence.*

In opposition to two electrical fluids, whose existence was maintained by Du Fay, Symmer, Coulomb, Turner, and Thompson, which theory I consider unphilosophical, I will here quote the opinions of Dr. Franklin, the celebrated electrician of our own country, who took strong and decided ground against this doctrine.

For it, he substituted the more simple theory of one fluid, and attempted to account for all the various phenomena of attraction and repulsion by the different states, or degrees, or volumes of electricity, which he called *plus* or *positive* and *minus* or *negative.* When a body had more than its natural share, it was

considered to be in a plus or positive state, and when it had less than its natural share, it was considered minus or negative. Bodies, upon this principal, are positive and negative relatively, or positive and negative *absolutely*. They are positive and negative *relatively*, when they are both plus, but when one has a greater amount than the other. They are positive and negative *absolutely*, when one has *more* than its natural share and the other less. But in each of those cases there is attraction, though much more feeble in the former than in the latter case. Franklin, however, found, after mature reflection upon the subject, that his theory was attended with one inexplicable difficulty. His penetrating mind could not solve it satisfactorily to himself. This difficulty was the repulsion of two negatives, which he confessed could not be explained upon the plus and minus theory, for, in this case, both would be minus, and there of course be an absence of what he considered to be the attractive and repulsive principle.

Epinus, however, a celebrated electrician of St. Petersburg in Russia, undertook to extricate the theory of Franklin from this dilemma. He maintained, with Franklin, that there is but one fluid, and accounted for all the phenomena of attraction and repulsion, including the repulsion of two negatives, upon he hypothesis that there must be a reciprocal affinity or attraction between ponderable and imponderable matter, and that the particles of each must be mutually repellant to those of their own kind, and mutual-

ly attractive to their opposites, and that this attraction and repulsion exerts itself in the ratio of inverse proportions according to the squares of the distance. This it will be seen, lays the basis for three distinct propositions.

1st. The particles or ultimate atoms of ponderable matter naturally repel each other.

2d. The particles or component parts of imponderable matter or electricity mutually repel each other.

3d. The particles or component parts of both ponderable and imponderable matter mutually attract their opposites, and that too with a force, which not only varies according to the squares of the distance, but, also, according to the magnitude and density of the one, and the volume or degree of the other.

Now from this explanation of the difficulty, which Franklin encountered, I dissent altogether. It destroys virtually that "*vis-inertia*" or inaction, which is an essential property of ponderable matter, and gives to it attributes, which it never possessed. That difficulty can be explained in a manner more strictly in accordance with fact, for the theory of one electric agent, as maintained by Franklin, is correct, his doctrine of plus and minus is also correct, but there are certain invariable *results*, which depend upon the plus and minus of bodies, which will fully explain the difficulty, which he encountered. We must look, not to the simple volume or degree, or amount of accumulation itself—not to the simple plus and minus, but to the organic laws of the ultimate component particles

of electricity, for the solution of the enigma, which so puzzled Franklin, which laws, however, invariably exhibit their operations through the medium of a plus and minus in bodies.

After a careful investigation of this subject, I am satisfied, that the difficulty can be perfectly solved. That solution is derived from a law of electricity, which, although it seems to have escaped the attention of chemists, can nevertheless, be demonstrated to exist, as easily and as perfectly, as any problem in Euclid, can be demonstrated. It is this. Every ultimate particle of electricity has opposite polarities—that is, each end of each individual particle has a different property—*like* ends or polarities repel, and *unlike* ends or polarities attract. This I intend to prove conclusively, by the aid of that immutable truth, that *the laws of the whole are the laws of its parts*, and by the operation of the rule, so proven, I intend to show that all the phenomena of attraction and repulsion among both atoms and planets, can be rationally accounted for. Let us apply the immutable and infallible rule, that the laws of the whole are the laws of its parts, and *see* whether it will sustain the opinion we have hazarded, and for which we derive no support from the books.

Electricity and galvanism are, at the present day, generally conceded to be the same agent. There is no dispute about that. Now, if you pass a current of galvanism around soft iron, bent into the form of a horse-shoe, and wound spirally, with insulated copper

wire, you make the iron magnetic, and the two ends have different polarities. By different polarities, I mean, that, what one end will attract the other will repel, or the one is negative and the other is positive. But by changing the poles of the battery and passing the current of electricity in a different direction around the spiral wire, you change the polarity of the iron, and make the end that was positive, negative, and the end that was negative, positive, which can be shown, by experiments in electro-magnetism. So then, positive and negative, in this case, depend upon the direction in which the current runs, for the current runs *inward* at one end and outward at the other. The end where the current is *inward* is *always negative*, and that, where it is *outward* is *always positive*.—And why is this invariably so. There must be a reason for this phenomenon. Its solution is readily found in the admirable rule, that the *laws of the whole are the laws of its parts.* If a current of electricity, running in a certain direction, makes one end of a bar of iron positive, and the other negative, each individual ultimate particle of that current must have an agency in producing such a result, and, therefore, each individual particle must have a positive and negative end, the positive end always leading, and the negative, of course, always following. We infer this from the fact that the laws of the whole, are the laws of its parts, or the laws of its parts are the laws of the whole; for it would be utterly impossible that the

whole of a thing should have a quality the *opposite* of the *parts* of which it is composed.

To make our position still more impregnable by fact, and argument, let us examine further. If you pass the galvanic current around steel spirally, in the same way as it passed around soft iron, you make it permanently magnetic, the end, where the current is *inward* is *negative*, but the end where it is *outward is positive*. So it will remain for years. Now you may cut up that bar of steel, which is thus made magnetic, into ten thousand *pieces* and *each piece* will have a positive and negative end, and the positive and negative polarities of the pieces will be arranged in the same direction as the whole. What, then, is the unavoidable and logical inference? Why, that *each ultimate particle of the electricity*, that made it magnetic and kept it magnetic, has *opposite polarities*, as well as the whole current;—because the polarities of the whole are, most assuredly, made up of the properties of its parts. A mere thimble full of the atmosphere, for instance, contains its relative proportions of oxygen and nitrogen, as well as the whole mass. A drop of water contains its relative proportions of oxygen and hydrogen, as well as the ocean, and so with every thing else. Further confirmation if confirmation it needs, will be given to this opinion, when we come to the subject of polarized light.

Having by fact, and by argument, attempted to prove that each end of the ultimate particles of electricity has opposite polarities, that the positive end is

always presented in the outward current, and the negative end, of course, in the inward current, we will now apply this theory to the explanation of phenomena of attraction and repulsion. But first, to show that the facts are true, which we have stated, we can prove them by an experiment with two magnets.

If, for illustration, two steel magnets, with like powers, be dipped into iron fillings, until they have accumulated as large an amount as they can retain upon their poles, and the opposite poles of each be then presented within a short distance of each other, the filings will spin out, and fill up the space between them, and exhibit an oily, ropy appearance. But, if like poles be presented, the filings will be blown back, as it were, and stand out like hair around the points of the magnet. This shows that there is attraction in the one case, and repulsion in the other.

Now then, for an explanation of the attractions and repulsions of electricity by this theory. A body which is charged plus or positive, has an emanation or an outward current. Such a body will attract a body charged minus or negative. And why? Because, as we have shown by the magnets, the outward current of the body charged plus present its positive end.—But a body in a minus state has an inward current of electricity, which it attracts from contiguous substances. Of course the negative end of the ultimate particles of this inward current is presented. And what is the consequence? Why two bodies, the one having an outward, and the other an inward current, pre-

sent opposite polarities to each other, and are attracted from the operation of the immutable law, that opposite polarities attract.

We now come to the solution of that difficulty, which perplexed Dr. Franklin so much—the repulsion of two negatives. Before the application of this rule the difficulty vanishes at once. When two bodies are minus or have *less* than their natural share, the current of electricity is inward into both. Now if, while the two currents are inward, the bodies in a minus state be brought near each other, they are repelled, because both currents being inward, the negative ends of the ultimate particles of each current are presented to each other, and they are repelled upon the principle that like polarities repel each other. Thus is all attraction and repulsion among material bodies, and of course, all motion produced by the agency of electricity alone, without the intervention or co-operation of inert matter. So that the difficulty, which Dr. Franklin encountered in his theory of plus and minus, is obviated without the aid of the unphilosophical assumption of Epinus and Cavendish, that matter has the property of repelling its own particles.

There is an experiment which will develope another very extraordinary and mysterious fact, respecting one of the inherent constituent properties of electricity, which we shall thoroughly investigate in this connection, and see, if it does not throw a flood of new light upon the phenomena of disease, the best methods of medical treatment in certain cases, and the

hidden organic causes and laws of chemical changes —of decompositions and recompositions. The fact to which I shall allude, is this:

If a person shall touch the negative end of the voltaic pile with a moistened finger, and bring a platinum or gold wire from the positive end in contact with the tongue, a strong acid taste will be perceptible in the mouth of the experimenter. But if the wire from the negative end be brought in contact with the tongue, while the moistened finger be placed in contact with the positive pole, there will, on the contrary, be produced in the mouth a strong burning or alkaline taste. Now why is this? The answer to this question might well of itself fill a volume, for it is a key to unlock the rich casket of a thousand mysteries. It cannot, therefore, be expected that I should do more than merely glance at the solution of this wonderful phenomenon in the space allotted for the completion of this lecture, and if, in my anxiety to do as much justice to the subject as can be done in a single lecture, I should extend my remarks somewhat beyond the ordinary bounds of one, I hope that my reader will not be offended with this burdensome tax upon his patience.

To proceed, then, why will the *positive* pole, when brought in contact with the tongue, produce an *acid* taste, and the *negative* pole an *alkaline* taste? We shall assume, in the first place, as the basis or data of our reasonings and deductions upon the subject, that it must be something *inherent* in the galvanic current

itself, or in some chemical change produced in the system by the course of the passing current, or in both combined. We believe it to be in both combined.

In our investigations of common electricity, it will be recollected that we established, upon the basis of a self evident proposition or axiom, that one end of its ultimate particles is opposite entirely in its nature to the other end, since one end of a current is attractive and the other repulsive, and, as the laws of a whole are the laws of its parts, then, of course, each atom of that whole has an attractive and a repulsive power, by the opposite polarity of its opposite sides. Now then, if, as is demonstrated in the experiment just referred to, the whole current has a taste, just in accordance with the direction in which it runs across the tongue, each ultimate particle, which aids in constituting that current and its organic laws, has, also, a taste in accordance with the direction in which *it* runs, as can be proven by the same process of reasoning.

It is demonstrated, then, by experiment and by deduction built upon self evident propositions, that each of the two ends of the ultimate particles of electricity have opposite tastes — the one an alkaline and the other an acid taste.

Now how admirably this fact exhibits the uniformity of nature's laws! How lucidly it proves that there is no clashing at all in the principles of her government. What a firm and immoveable basis it lays for confidence, that, when we have ascertained, beyond the possibility of a doubt, one isolated fact, proving

the existence of a certain definite law, other facts, when discovered, will harmonize with the evidence of the first fact, if they relate to the same subject or class of subjects, and will increase the weight of proof as to the exisitence of such a law, thus chaining the uniform testimony of isolated facts together into an harmonious and irresistible convincing sum total of proof, and thus giving a satisfactory and almost mathematical certainty to our knowledge!

What is the corroborating testimony of facts in the case under consideration? It is this. We have already demonstrated, by a series of deductions, based upon experiments, that the two ends of every ultimate particle of electricity have opposite polarities — that, when a body is charged plus, there is an emanation — that, in every emanation or outward current, the ultimate particles of the agent, that constitutes it, present their positive end, as that always leads — that a minus body has an *inhalation* of the electric breeze, as it were, or an inward current from surrounding substances, and is negative, because the rear end of each particle, or that which always follows the lead of the positive in all the movements of electricity, is, in its organic constitution, negative.

Now then for a forcible illustration of the admirable uniformity of those facts, which demonstrate nature's laws. When a current of electricity runs *in* at the tongue, it leaves an *acid* taste, and when *out* of the tongue, an *alkaline* taste. Now this inward current, as we have before frequently remarked, presents

its *negative* end and the outward its *positive* end.—In the inward current, the negative end of each particle as it passes in, gives inherent organic taste, and so with the other. Now, in what electrical states are the alkalies and the acids? Why exactly in *opposite* states. The acids are negative and the alkalies are positive. The inward current has a *negative* polarity, and is also *acid*, and the outward has a *positive* polarity and is *alkaline*. The positive and negative, then, in both cases — yea in the whole three cases agree perfectly, both as to *taste* and *polarity* — the taste of the negative end of a current being acid, which acid in the form of salts is also negative, and the taste of the positive end of a current being alkaline, which alkaline, in the form of salts, is also positive. The strong chemical affinity which exists between the alkalies and the acids is familiar to all. Tartaric acid and soda, for instance, when brought in contact with each other in solution, are attracted to each other, a powerful effervescence ensues, and a chemical union is formed between the two. Now this attraction must be entirely owing to the attraction of positive and negative electricity, or of opposite polarities, since the one is plus and the other minus, and since a foundation seems to be laid for an alkali and an acid in the organic constitution of the ultimate particles of electricity itself.

There is one more important fact illustrative of the wonderful effects of electricity upon the animal system, which I will introduce here, and then close the lecture.

Dr. Ure, of Glasgow, performed, some time since, upon the body of a murderer, who had been hung, several experiments, with a battery consisting of two hundred pairs of 4 inch plates.

1st. One pole of this battery was introduced into an incision in the nape of the neck, so as to come in contact with the spinal marrow, while the other was applied to what is called the sciatic nerve. The consequence was that every muscle of the body was agitated with a convulsive quiver, as if violently shuddering from the effect of cold.

2d. By continuing one pole in the nape of the neck, as before, and removing the other to an incision made in the heel, the knee being previously bent, the leg was thrown out with such force and violence, as nearly to kick over one of the assistants, who endeavored to prevent its extension.

3d. One pole was inserted into an incision made to what is called the phrenic nerve, and the other between the ribs, so as to touch the diaphragm at the bottom of the lungs. The consequence was that the chest rose and fell as in heavy natural breathing.

4th. One pole was brought in contact with the supra-orbital nerve in the forehead, and the other with the heel, when every muscle of the countenance was simultaneously thrown into fearful action. Rage, horror, despair, and ghastly smiles united their hideous expressions in the murderer's countenance. So horrid was the sight, that several spectators were

forced to leave the room in which the experiments were made, either from terror or sickness, and one gentleman fainted.

5th. One pole was inserted again in the nape of the neck, and the other brought in contact with the ulnar nerve at the elbow. Immediately the fingers moved nimbly like those of a violin performer. An assistant tried to close the hand, but found it would open forcibly in spite of his efforts. When the rod was removed from the elbow to a slight incision in the forefinger, the fist being previously clenched, that finger instantly extended, and, by the convulsive agitation of the arm, the murderer seemed to point to the different spectators, some of whom thought he had come to life.

LECTURE VII.

THE SINGULAR PROPERTIES AND ELECTRIC QUALITIES OF LIGHT AND HEAT ILLUSTRATED FROM ARGUMENTS DRAWN FROM VARIOUS SOURCES.

As much was said during the discussion upon the origin of the globe about the manner in which the sun was created, and the influence of its light upon our globe during its various stages of organization, it will be quite appropriate in this connection to consider somewhat minutely the essential properties of the substance of the sun and the element of light. By such an examination we think that they both will appear very different from the qualities with which they have been invested by certain crude notions which have been entertained respecting them. We cannot better give our views upon this subject than by quoting from our own work published in 1843, entitled "A New Philosophy of Matter."

The sun is to be regarded as the fountain, from which continually flows all natural light, for, it will appear conclusively in the course of our observations, that it would be utterly impossible to produce fire were it not for the existence of this agent. And here an interesting question respecting its nature and essential properties forcibly suggests itself to the mind:

What is light? It seems to be a subtle, ethereal, all pervading fluid. No sooner does it glance upon a substance than it is gone. Suddenly darken a room into which a strong flood of light is pouring, and it is all dissipated as instantaneously as thought. Not a solitary ray is left to illuminate the darkness. Blow out a candle, whose light can be seen by the eye, at any point for a mile in every direction around it, and which, therefore, completely fills several cubic miles of space, and not the minutest iota of time does that light continue, after the candle is extinguished. A thunder bolt blazes across the black canopy of a midnight of storm, and its scathing light fills perhaps a thousand cubic miles of space. Blinded by the intense and lurid glare, the eye of the beholder shuts for an instant, and opens—upon what?—A darkness deeper, if possible, by contrast, than before. The lurid flash has gone.—Where? Is it annihilated? No. It is somewhere in a state of diffusion, and consequent invisibility, and if collected under the same circumstances, it would exhibit the same flash as before, and again diffuse itself through the mass of surrounding substances. Light, then, as we have already remarked, is subtle, ethereal and all-pervading.

It is imponderable too—that is, it can be neither weighed nor measured. When a ponderable substance of several tons bulk, is completely saturated with it, the specific gravity of that substance is not increased the smallest perceptible particle.

Never, for an instant, is this subtle agent stationa-

ry. The lightning speed of its everlasting career can be compared with no other agent in nature except Electricity. It glances quick as thought from heaven to earth—from the sun to the planets.

There are two theories respecting the substance or essentiality of light, both of which will, for a moment, be examined. Dr. Herschel and his coadjutors supposed that it was the effect of the undulation or vibration of a subtle, etherial medium every where present in nature, and that it is transmitted to the eye the same as sound is to the ear. Upon this hypothesis there would be no direct communication between the sun and the earth, or the other attendant planets, and this being the case, the generally received opinion among philosophers, that the movements of the planets are governed by a certain kind of influence exerted by the sun over them, would be erroneous; for we hold it to be a truth capable of the clearest and most logical demonstration, that there cannot be any influence exerted by one substance over another, without a direct and a positive connection, of some sort between those two substances. To suppose the contrary, would be to suppose that there is a connection, and that there is not a connection in the same breath, which is a self-evident contradiction in terms. We hold such an influence, without such an actual connection, to be an impossibility in the nature of things, which, to speak reverentially, not even Omnipotence can overcome, for God himself never claims to do that which is an impossibility in the nature of

things. But it may be said that the Almighty created the universe with a word, and that there is no positive connection between a mere word and such a stupendous effect. True, but if he created that universe with a word, his all pervading Omnipotence was present to give that word efficiency ; for to suppose the contrary, would be to suppose that God can withdraw himself from a positive connection with his own agencies, which is another self-evident contradiction, unless you can undeify the Deity and make infinity finite.

Besides, the opinions of Dr. Herschel, upon this subject are unphilosophical and contrary to known facts. Instead of undulating or vibrating, light moves in direct lines. This is capable of positive proof. The angle of incidence and that of reflection are the same. Let a stream of light fall upon a mirror at a particular angle, and it will be reflected from that mirror in an exactly opposite angle.—It is a tested and acknowledged fact, also, that light will not pass through a bent tube. But if it moved in undulations or vibrations like sound, this would not be the case, for sound *will* pass through such a tube. These facts and arguments, therefore, prove that the hypothesis of Dr. Herschel, respecting light, is false and unphilosophical.

The other theory, of which we spoke, is that of Sir Isaac Newton. It was the opinion of that great philosopher, that solar light is an infinitesimal effluvia of matter or an emanation of inconceivably minute par-

ticles flying off from the body of the sun, and darting in straight lines through that space which is occupied by those opaque bodies which are governed by its influence. This hypothesis we consider to be correct and philosophical, if we regard it as an emanation of matter, different in its nature and essential properties from ponderable, inert matter—if we regard it as an imponderable essence, as it doubtless is, governed by the very same laws, and exerting precisely the same agencies as the other imponderable principles. Newton, however, left some things unexplained in his theory of solar emanation, which, unless satisfactorily accounted for, would involve the subject in an inexplicable difficulty. Although he maintained the opinion that light was constituted by a flight of particles from the sun, and thus far was doubtless correct, yet he neglected or failed to account for the supply of that waste of the substance of the sun, which must unavoidably be the consequence. The objector to his theory, who might wish to puzzle the philosopher, might put the question, "if light be an emanation of infinitesimal atoms or particles of matter from the orb of day, why is it not diminished—why not exhausted and blotted out?" And such a question too would be a very natural one, and deserving of attentive consideration. Light is constantly emanating from the sun. This is a known and a generally acknowledged fact in science. Every conceivable point of space for ninety-five millions of miles around that luminary to the orbit, of our

earth, and so around the whole circumference of that orbit is constantly filled with this light; and as light is estimated to move from the sun to the earth in eight minutes, then this whole entire ocean of light, one hundred and eighty millions of miles in diameter and nearly five hundred and forty millions of miles in circumference, containing billions upon billions of cubic miles of light diffused over space, is displaced every eight minutes by a new emanation—a fresh ocean of light, and that by the flood-tides of another ocean, and that by another, and so on to infinity.

Nor is this all. The whole space between us and the far off orb of Herschel is thus constantly filled with light, and that light is thus constantly displaced, by wave succeeding wave in endless succession.

Now the idea that this is matter, which is thus passing off from the sun with the glance of the lightning flash, and filling every eight minutes an almost inconceivable area of space, would be preposterous in the extreme, unless there were, by some process of nature, an adequate supply for such an immense and unavoidable waste. This conclusion is in strict accordance with every principle of philosophy, analogy and fact. It is perfectly evident that particles flying off from a body must inevitably diminish that body. No matter how infinitesimally minute those particles, nor how immensely large the substance, this must be the case, so long as the smallest atom of matter conceivable possesses both length, breadth and thickness.

It can, then, be mathematically demonstrated, as perfectly as any problem of Euclid, that the sun, unsupplied from some source, would, long since, have been frittered away by infinitesimal abstractions, and been utterly annihilated by this waste, even though we should, for the sake of argument, adopt the supposition, that a million of cubic acres of those particles, when condensed sufficiently, should weigh no more than the ten thousandth part of a single grain; for, however vast in magnitude be the substance, such a diminution as must take place by an emanation of particles so immense as to fill a cubic bulk of space one hundred and eighty millions of miles in diameter, and nearly five hundred and forty millions of miles in circumference, every eight minutes, must certainly annihilate that substance completely in process of time. As "a continual dropping wears away the solid rock," so a continual waste must eventually exhaust—completely and utterly exhaust even the bulkiest mass conceivable.

If light then, be the emanation of infinitesimal effluvia from the sun, as it doubtless is, how shall we rescue the Newtonian theory from the difficulties in which it seems to be involved? We must suppose either that there is, somehow, an unseen and imperceptible return of those particles, to the source, from whence they emanated, or that that great fount of light is constantly fed by creative agency constantly exerted, or else, as the horrid alternative, that the world would long since have realized the terrific phantasies of Byron's poetic dream on darkness, when—

'The bright sun was extinguished, and the stars
'Did wander darkling in the eternal space,
'Rayless and pathless, and the icy earth
'Swung blind and black'ning in the moonless air.'

The latter alternative, we know, however, has not taken place, and the position, that the waste is supplied by direct creative agency, is contrary to all the analogies of divine economy. When the Almighty created the universe, he created, also, it is presumed, all the natural laws and agencies by which that universe should be governed, until the present order of things shall be broken up by the same Omnipotent word and energy which established it, and,

"Final ruin fiercely drive her ploughshare o'er creation."

He did not leave his work half done. He completed creation—he pronounced the whole good, very good, and on the seventh day he rested from his labor. It cannot be presumed that the process of creating new materials to supply any deficiency in this splendid machinery of worlds is now progressing. The supposition would be derogatory to the skill of the great architect. It would be contrary to the analogy of all his doings. Although there are continual changes going forward in the materials of which this globe and its surrounding atmosphere is constructed—although there be a ceaseless progression of chemical decomposition and recomposition among various substances—although what was a tree, one year, may, by transformation, become glass the next—or what was grass one day may become either flesh or milk or

cheese or butter the next—or what was fish in one age may be petrified into limestone the next, and, instead of floating in the water, become the material with which your parlors are plastered, yet, it is presumed, that not a single new particle has been added to the globe or its varied furniture since creation, however modified it may have been, either by nature or art. One might imagine, perhaps, that, in the combustion of fuel, there is some destruction of material. But such is not the fact. It has only undergone a change. Every particle of it exists some where either in vapor or smoke or the gasses or in ashes. And so with everything else. When the streams dry up in the seasons of drouth, there is not a drop the less water than before. It is either in the deep well springs of the earth, or is borne about in the vapors of the atmosphere, nor is there a drop more when the streams are full, nor was there, when the windows of heaven were opened, and the fountains of the great deep were broken up, and the deluge covered fifteen fathoms deep, the tops of the highest mountains. It was either spouted up from the subterranean reservoirs of earth, or the surrounding atmosphere, which extends forty-five miles above the globe, gave out its watery treasures, or the melted icebergs came down in torrents from the arctic and antarctic seas.

From these analogies, and a thousand others unmentioned, we infer that no creation of material is progressing to supply the waste of the sun. Shall

we then resort to the other hypothesis, that the otherwise unavoidable diminution of the sun is supplied by the return, through some channel, of those same particles, which have accomplished the object of their mission? Let us see what testimony analogy furnishes upon this important subject, before we hazard an answer. The human body affords a good illustration. The heart sends out the vital stream by successive pulsations, through its purple channels, to the extremities of the system, and is, in its turn, supplied by that same blood, which is sent out in its passage back through the little veins, to be again projected by the self moved action of the wondrous machine.

The waters of the globe afford another very good illustration. The ocean is, as it were, the heart of the earth. By evaporation it supplies the clouds with water. This is borne over the globe and discharged among the mountainous regions, to supply the high lakes and fountains. These send forth the little rills and streams, which, uniting in their course, form rivers, which empty into the ocean again and keep that immense reservoir unexhausted. Now, what the heart is to the human body, or the ocean to the globe, I conceive the sun to be to the solar system. By its mighty pulsations, it sends out its living streams to vitalize and energize creation, and when one pulsation has done its work, and given its share of the mantling blush of health to the cheek of beauty, and of luxuriance to the verdure of vegetation, and of varied tints to the flowers, and of ripeness to the mellow

fruits, and of motion to the planets, it speeds on its lightning circuit, and gives place to another pulsation, and thus pulsation after pulsation chase each other in one interminable and ceaseless round, supplying by some hitherto inexplicable method of return, the waste which must otherwise accrue.

We have considered the Newtonian Theory of the materiality of light as correct, though not matter in the common acceptation of the term, for it is totally different from any tangible, appreciable form of matter with which we are acquainted — being imponderable, and immeasurable, passing through transparent mediums without seeming to encounter any obstacle — entering readily into the eye, the tenderest and most delicate organ, without causing pain or being perceptible in its passage. The following appropriate extract from Ferguson's Astronomy will forcibly illustrate the extreme subtlety and imponderability of this agent. "Light consists of exceeding small particles of matter isusing from a luminous body; as from a lighted candle such particles of matter constantly flow in all directions. Dr. NIEWENTYT* computes, that in one second of time there flows 418,660,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000 particles of light out of a burning candle; which number contains at least 6,337,242,000,000 times the number of grains of sand in the whole Earth, supposing 100 grains of sand to be equal in length to an inch, and consequently, every cubic inch of the Earth to contain one million of such grains.

*Religious Philosopher, Vol. III. p. 65.

These amazingly small particles, by striking upon our eyes, excite in our minds the idea of light; and, if they were as large as the smallest particles of matter discernable by our best microscopes, instead of being serviceable to us, they would soon deprive us of sight by the force arising from their immense velocity, which is above 164 thousand miles every second, or 1,230,000 times swifter than the motion of a cannon-bullet. And therefore, if the particles of light were so large, that a million of them were equal in bulk to an ordinary grain of sand, we durst no more open our eyes to the light, than suffer sand to be shot point blank against them."

Now, with respect to extreme subtlety, does not light resemble electricity. Is there any other agent in nature, which will pass thus through the eye without affecting it except electricity, for that will thus pass. Let a pointed rod be connected with an electric machine, and a stream projected through the eye from that point will cause no more pain than light — though differently modified. And if light be electricity, there would be an additional argument in favor of the supposition, that emanations of this fluid return again to their source, the sun, as all electricity, however modified, moves in a circuit, and exhibits no effect except the circuit is closed.

This is doubtless a novel idea, and may, for that reason alone, be considered, at first thought, chimerical and baseless. But we only ask calm reflection upon the subject, and candid attention to it, for, we are

persuaded, that, after mature consideration, it will not appear so visionary, as may, at first glance be supposed. If it perform a circut, it must be so immense, as to be beyond computation. To illustrate this subject, trace a single ray, for instance, in its passage from the sun, out into space, for millions upon millions of miles, and there would be a point in its outward passage, and its consequent continual divergence, that the ultimate particles, which constituted that ray, must of necessity begin to separate from each other. Now, when they come to that point of incipient separation, what becomes of them? If they make a complete circuit, as we believe they do, the ultimate particles, which composed the ray, would, when they began to separate, (if they have the same organic laws as electricity, which we shall prove,) present their negative or minus polarity toward the sun, and, in that separated state, they would be drawn back to their source by the simple laws of the attraction of opposite polarities.

But it may be affirmed that, as light moves in straight lines, one part of our theory clashes with another, since, according to this view of the subject, it must move in *curved* lines. This apparent clashing, however, is very easily explained, and this objection obviated. So inconceivably immense is that orbit, which is described by a ray, that, although it is *actually* circular, yet any perceptible part of the orbit, which it describes, would appear to be *straight* to us, and thus there be no clashing between the two positions in reality.

It would be very easy, we are aware for a fruitful imagination to invent objections, but before our conclusions be confidently and positively denied, we would ask those, who would invent such objections, to tell us what becomes of light, if it does not thus move in a circuit and thus return to its source. Is it annihilated, or does it become stagnated and dormant and lose its inherent activity in the vast abyss of space? And if it move not thus, and return, we would ask those, who invent such objections, if they are prepared, in any other plausible or rational way, to account for the otherwise unavoidable waste of the material of the sun. If they can, we will willingly become learners, and will pledge ourselves to give up all prepossessions in favor of any opinion which we may have harbored. But if they cannot, they are bound, we think, to consider well the propriety of making objections upon a subject, when they know not positively whether their objections are well founded. Firmly believing, however, that they cannot, we shall, for the present, at least, adhere to the conclusions to which we have already come.

Light then doubtless, after having performed its office returns to its fountain and thus closes its circuit. Else, what, I ask, becomes of it? Has the earth, for instance drank in and retained all the light which has been shed upon it by the sun since creation? If it had we conceive it to be a proposition capable of the clearest demonstration, that it would have been, by this time, a complete ball of light like the sun.

Besides had it retained all the rays which have fallen upon it since the morning of time, its bulk ere this, would have been very sensibly increased; for, although light be imponderable, yet it is something, and is capable of accumulation, like other matter, if retained. Not only would the earth be increased by this accumulation, but every planet of the solar system, and the sun, as every one must see, would be proportionably diminished. And what would be the consequence of such a diminution of the one, and increase of the others? Why, the perfect balance of the system, which produces such a wonderful regularity of revolution, that eclipses can be foretold, for years before their occurrence, to the definiteness of a single moment, would be entirely destroyed, and the whole would rush headlong to the confusion and darkness of chaos. Neither the earth, therefore, nor the other bodies of the solar system have retained the light, which has fallen upon them, but having been as completely saturated, the first twenty-four hours of their existence as ever, they have thrown off all superabundance, the same as substances do, when surcharged with electricity.

We have dwelt upon this subject of the return of particles to the sun with the more minuteness, because, if true, it may account satisfactorily for an important phenomenon, to which we shall have occasion to advert hereafter.

As the correctness of our theory depends mainly upon the demonstration of the proposition that light

is electricity, we will proceed in the examination of proofs. The two possess many properties in common. Light, generally speaking, is attended with heat—so is electricity. Light has inconceivable rapidity of motion—so has electricity. The one is imponderable, immeasurable, all-pervading—equally so is the other. And what if they do vary in some of their appearances—vary in some of their effects and operations? Does that circumstance necessarily destroy their identity—their oneness in principle or in essence? Certainly not. Known and acknowledged electricities thus vary, and that too, quite as widely. The spark and the shock of the electric machine are somewhat different from the galvanic current. The meteoric shower is different from the keen flash and fierce energy of the bursting thunderbolt. The blaze of the thunderbolt is different from the mysterious corruscations of the Aurora Borealis and Aurora Australis, and these again are all different from magnetism or magneto-electricity.—Even the very same galvanic current, when modified by machinery, as can be demonstrated with a piece of apparatus, is different under one set of circumstances, from what it is under another. If a person take hold of the poles of a small battery, and close the circuit, he receives no shock. But pass that same current around a helix of copper wire, enclosing soft iron, and forming what is called the magneto-electric machine, and then, by the action of the machine, a person receives shocks whenever he closes the circuit, by taking hold of tin tubes

having a connection by conducting wires with the positive and negative poles of the helix. This proves *conclusively* that dissimilarity in appearance or in action destroy not identity or oneness in principle or in essence. This dissimilarity depends on modification and on that alone, the causes of which are, sometimes, apparent, and sometimes latent. The want then, of resemblance in any respect between light and electricity, destroys not necessarily their identity. And even on the score of similarity, they are, by no means, materially deficient. There are, in fact more points of marked resemblance between them, than between many known and acknowledged electricities—more, for instance, than between the Aurora Borealis and magnetism. And were the attention of philosophers and chemists turned to the investigation of this subject with all that intensity which its importance demands, we are persuaded, that more resemblances still would be discovered. Who can tell, but that, if, by any means, an immense number of rays could be brought together into one line of light, as they are brought to a focus by the lens or burning glass, and could they be continued onward in that line, without being scattered—who can tell, we say, but that this condensation of rays might be one continual stream of fire, like that of the electric fluid ?

But a truce to supposition. We need not resort to hypotheses or conjectures to establish the plausibility, or even the logical *certainty* of our argument. We appeal to *incontrovertible* facts, to prove that

light is electricity. These facts we shall glean from the observations of practical men, which are preferable to any philosophical surmises or speculations.

Lieutenant Johnson, of the British navy, often noticed that a considerable variation of the needle of the compass was produced by the rays of the sun falling upon the glass which covers it.

In support of this testimony, I have that of Mr. Harris, a resident of Ravenna, Portage county, Ohio, who had been a surveyor more than twenty years, and who had often been engaged in running lines. In the commencement of his business, he was often much troubled by the variation of the needle, and imputed it, at first, to the vicinity of iron ore, which is the popular solution generally given for such phenomena. But he noticed, after awhile, that the variations occurred in a cloudless day, and just about noon, when the sun was vertical. The idea occurred to him, that it might be electricity, produced upon the glass cover by the sun's rays. In order to test the correctness of that idea, when such variations occurred, he moistened the glass so as to dissipate the electricity, and found by so doing, that the variation was instantly prevented.—Since that, he affirms that he has been no more troubled with the supposed attraction of metalic substances, and his remedy is an infallible preventive of the variations that so much troubled him.

Since we first commenced the particular investiga-

tion of this subject, in 1838, we have had frequent opportunities to consult the oldest and most observing practical surveyors, and they have, without an exception, in every instance, corroborated the statements of Mr. Harris, and Lieutenant Johnson. One whose name, for particular considerations, we shall omit, but who was as good authority, probably, as any one we have consulted, not only testified his firm belief in the cause assigned by Mr. Harris, but suggested the thought, that both diurnal and annual variations of the needle might, possibly, be determined by the variations even of the thermometer.

But some may, perhaps, be willing to acknowledge the premises, from which we started, but deny the validity of our conclusions.—They may assent to the proposition, that electricity causes such variations of the needle, as we have been contemplating, and that electricity may be produced by the mere friction of the sun's rays upon the glass cover of the compass, but, that it cannot be the sun-light itself. This, however, would be an assumption altogether unreasonable and unphilosophical. Even if produced by the friction of the rays, (which cannot be the case, since light passes so readily through a transparent medium, without friction,) either the light or the glass must give out the electricity; for, in all cases, where electricity is developed by friction, either the rubber or substance rubbed produces it. The one substance, that affects the other, is, uniformly, the substance that

is the generating agent. Even if light, then, produces electricity by friction upon the cover, it, after all, develops it from its own substance, and so, nothing is gained by the objector, nor are our conclusions at all impaired.

LECTURE VIII.

THE SINGULAR PROPERTIES AND ELECTRIC QUALITIES OF LIGHT AND HEAT ILLUSTRATED BY ARGUMENTS DERIVED FROM VARIOUS SOURCES.

In addition to the facts, which were introduced into our last Lecture, and which were of themselves sufficient to demonstrate that light is electricity, it has been ascertained by the celebrated Mrs. Somerville, of England, that by passing the sun's rays through a prism, and separating them, by analyzation, into the seven primitive colors, the blue color possesses the power of imparting magnetism or polarity to the needle, and *magnetism*, we now know, to be electricity by experiments too conclusive to be controverted.

There is another very important fact respecting the organic laws of the constitution of both light and electricity, which furnish additional and weighty testimony in favor of identity. The attractions of electricity decrease in exact proportion as the squares of the distance increase, in receding from an electrified body. This is precisely, (as we should suppose,) the law of the divergence of light, and this law, which runs throughout all the imponderables, has its origin in the law of solar emanation or divergence, and the simple reason why the attraction of all bodies decreases in proportion as the squares of the distance increase, is

because the emanating influence of all bodies, which constitutes attraction, obeys this law.

The very strongest testimony, however, in proof of our proposition, is contained in the phenomena of the polarization of light, by which it is *demonstrated*, that every particle of light, as well as of electricity, *has opposite polarities*. This curious subject will be more fully examined, when we come to the discussion of the subject of caloric.

By a fair logical deduction, then, with facts amply to sustain it, we unhesitatingly infer that *light is electricity*.

Heat or caloric comes next in the order of remark, and, in the investigation of this subject we shall accumulate such an additional array of facts as shall establish our proposition beyond the shadow of a doubt.

The same arguments which would prove that light is an electric fluid are applicable, also, to the agent of heat. Heat like light is imponderable, subtle, ethereal and all-prevading. No obstacle can stay its *passage*. It insinuates itself between the particles of the densest bodies as though it were immaterial. Its power is prodigious—irresistible in its energies. It generates the tremendous power that propels the steam boat; and were it, or could it, by any means, be confined in subterranean volcanic caverns with bands strong enough, and there accumulated, it would, by the power of its expansive and explosive force, burst the solid globe to atoms, and send its shattered fragments in every direction through the vacuum that surrounds it.

With a glass bulb and tube, for instance, one of the energies of heat, can be forcibly demonstrated. By inverting it, and inserting the open end in a basin of water in its natural state, you will perceive no effect whatever. But, by passing into the tube the subtle agent of caloric from a spirit lamp, and again inverting it, you will see the water rise with great rapidity, and fill more than nineteen twentieths of the tube. This shows that heat has the power to expel the atmosphere and occupy its stead. But the moment you attempt to confine it there, by closing the tube, it is gone, like a flash—gone like a viewless, incorporeal, intangible thing, and the water rushes up to fill that vacuum.

If all the imponderables, as we have assumed, be identical, then Light and Heat are the same—they coexist and are inseparable. But, it may occur to some one, that those phosphorescent substances, which emit light, do not, also, emit heat, and that our position is, therefore, untenable. This conclusion is, however, altogether too hastily formed. It will be seen, by the following lucid extract from Turner, that heat is *always* necessary to make substances phosphorescent.

"The chemical agency of artificial light is analogous to that from the sun. In general the former is too feeble for producing any visible effect; but light of considerable intensity, such as that from ignited lime, darkens chloride of silver, and seems capable of exerting the same chemical agencies as solar light, though in a degree proportionate to its inferior brilliancy.

Light is emitted by some substances, either at common temperatures, or at a degree of heat disproportioned to the effect, giving rise to an appearance which is called phosphoresence. This is exemplified by a composition termed Canton's phosphorus, made by mixing three parts of calcined oyster-shells with one of the flowers of sulphur, and exposing the mixture for an hour to a strong heat in a covered crucible. The same property is possessed by chloride of calcium (Homberg's phosphorus,) anhydrous nitrate of lime (Baldwin's phosphorus,) some carbonates and sulphates of baryta, strontia, and lime, the diamond, some varieties of fluor-spar called chlorphane, apatite, boracic acid, borax, sulphate of potassa, sea-salt, and by many other substances. Scarcely any of these phosphori act unless they have been previously exposed to light; for some diffused day-light or even lamp-light will suffice; while others require the direct solar light, or the light of an electric discharge. Exposure for a few seconds to sunshine, enables Canton's phosphorus to emit light visible in a dark room for several hours afterwards. Warmth increases the intensity of light, or will renew it after it has ceased; but it diminishes the duration. When the phosphorescence has ceased it may be restored, and in general for any number of times, by renewed exposure to sunshine; and the same effect may be produced by passing electric discharges through the phosphorus. Some phosphori, as apatite and chlorophane, do not shine until they are gently heated; and yet, if exposed to a red

heat, they lose the property so entirely, that exposure to solar light does not restore it. Mr. Pearsall has remarked that in these minerals the phosphorescence, destroyed by heat, is restored by electric discharges; that specimens of fluor-spar, not naturally phosphorescent, may be rendered so by electricity; and that this agent exalts the energy of natural phosphori in a very remarkable degree. The theory of these phenomena, like that of light itself, is very obscure. They have been attributed to direct absorption of light, and its subsequent evolution; but the fact, that the color of the light emitted is more dependent on the nature of the phosphorescent body, than on the color of the light to which it was exposed, seems inconsistent with this explanation. Chemical action is not connected with the phenomena; for the phosphori shine in vacuo, and in gases which do not act on them, and some even under water.

Another kind of phosphorescence is observable in some bodies when strongly heated. A piece of lime, for example, heated to a degree, which would only make other bodies red, emits a brilliant white light of such intensity, that the eye cannot support its impression.

A third species of phosphorescence is observed in the bodies of some animals, either in the dead or living state. Some marine animals, and particularly fish, possess it in a remarkable degree. It may be witnessed in the body of the herring, which begins to phosphoresce a day or two after death, and before any vis-

ible sign of putrefaction has set in. Sea-water is capable of dissolving the luminous matter; and it is probably from this cause that the waters of the ocean sometimes appear luminous at night when agitated. This appearance is also ascribed to the presence of certain animalcules, which, like the glow-worm of this country, or the fire-fly of the West Indies, are naturally phosphorescent."

Light and heat, then, we regard as the same thing. They co-exist and are inseparable. All the perceptible difference between them, consists in volume or degree *alone*, and not in nature. Light exists either *radiant* or in a state of *diffusion*, and, consequently, *latent*. It is *radiant* when coming from the sun to the earth, but the moment it strikes the earth, it becomes latent, but it is still *light*, just as much, though not seen, as it was before, and, could it be condensed into the same compass, and under the same circumstances as before, it would become just as radiant as before.

Heat is only light in a state of diffusion, as we before remarked. This is proven by the fact, that, if you condense it sufficiently, you make it light. Take a piece of iron, for instance, and heat it to a certain point, and it is still latent, or invisible, but condense a trifle more heat, upon the iron, and it begins to be light—condense more still and it grows lighter and so continue and you make it glow, at length, with a radiance almost as intense as that of the sun at noonday, but still it is only heat. Light, then, is only heat

condensed, and, the more it is condensed, the more intense is that radiance; and, on the other hand, heat when latent, or invisible, is light in a state of diffusion. All the difference, then, between the two, is in volume or degree, and in volume or degree *alone*.

The same remarks apply with equal force to electricity. When condensed in the electric spark, or in the galvanic current, or in the blazing thunderbolt, it is *radiant* electricity, but, when not condensed, it is *latent* electricity, or electricity in a state of diffusion and invisibility. But, whether radiant or latent, it is the same thing, precisely, only accumulated in different volumes.

Some suppose, that, when the electric spark, or the thunderbolt explodes, the electricity is destroyed.—That, however, is an erroneous supposition, as can be proven by experiment. It only passes into a state of diffusion, and consequent invisibility, but is essentially the same thing as before, and, could it be collected again, would exhibt the same appearance, as before, and explode in a flash equally intense.

Mr. Cross, a literary gentleman of England, passed several conductors for some distance over the trees in his park, and connected them all with a single one, which passed down through his parlor. In this main conductor, which passed through his parlor, he had a joint, so constructed, that he could break the connection, and leave a short interval between the two sections. Whenever he made the separation, whether in fair weather or in foul, there was a constant succession

of brilliant electric sparks, passing from one conductor to the other. Without this disconnection, the electricity would have passed over the conductor in just as great a volume, but would have been invisible or latent, and, of consequence, been the same precisly as if radiant.

The fact that luminous and invisible electricity are the same, though condensed more, in one instance than in the other, can be incontrovertibly proven, by an experiment with what is called the spiral tube or diamond neck lace. Over the glass, at very small intervals, are glued little pieces of tin foil. There is probably a hundred of those pieces, in a distance of two feet, and, as many spaces between them. Now, communicate a spark of electricity, either from the electric machine or a charged Leyden jar, and, in its passage through the tube, it will become alternately luminous and latent one hundred times in the distance of two feet, which, certainly, would not be the case, if electricity is destroyed or changed at all by explosion. It is latent, when passing the tin foil, and luminous, when passing the intervals, simply because it is more diffused upon the tin foil than in the spaces. Such an alternate arrangement of tin foil and spaces might be extended, until they should number many millions, and an electric spark would become alternately luminous and latent as many millions of times, in its passage over them. All the difference, then, between radiant and invisible electricity is in volume or condensation, and light and heat, as we have seen, exhibit precisely the same analogies.

We will here briefly enumerate a mass of additional facts, which show the identity of caloric, light and electricity.

Good conductors of heat are also good conductors of electricity, and poor conductors of one are poor conductors of the other.

Heat affects bodies inversely according to the squares of the distance. This is the organic law of light, electricity and magnetism. It speaks volumes in favor of the proposition that the sun is the fountain of all electricity, since the basis of this principle, which runs through all the imponderables, seems to be laid in the law of the divergence or radiation of light.

Heat radiates in all directions like light, and its angle of incidence and of reflection are the same.

Vessels containing a hot liquid will radiate heat much faster, if they have a rough surface, than those which have a smooth and polished one. The reason of this is, because the rough surface has a great number of minute *points*, from which the heat will escape, the same as electricity. The polished vessel has no *points* for radiation, and, therefore, retains the heat.

In accordance with the same law precisely, a polished vessel, containing cold water, when placed before a fire, will not be heated so quickly, as one having a rough surface, because it presents no *points* to attract heat, but reflects it rather.

That was an important era in the history of science, when the lightning of the clouds was identified with

electricity. Quite as important will be the era, when *caloric* and that lightning shall be demonstrated to be one and the same thing. If that ever take place, the propositions we have assumed will be proven to be correct, beyond the possibility of cavil, or the shadow of a doubt. This subject, then, is richly worthy of a thorough investigation. What are the phenomena attendant upon a thunderstorm, and what are the causes which conspire to produce it? Storms, attended with thunder and lightning, seldom occur, except in very warm weather; and the warmer the weather, the more frequent they are, and the more vivid, rapid and intense are the lurid flashes of the red bolt of heaven. They prevail in the northern zones in the summer, in the southern in the winter, and in the torrid regions throughout the year. This is the "modus operandi" of their doings.

During the hot weather of the summer months, a vast amount of caloric is poured down from the sun, and diffuses itself throughout the waters of the fountains, rivers, lakes and oceans of the globe, and produces evaporation; for, it is a fact, which is generally acknowledged, and which no one will dispute, that caloric is the vaporizing agent the world over. This vapor, when generated, rises, we know, and forms the clouds. The caloric or heat, which originated it, is absolutely required to keep it in a state of vapor; for, the moment it is abstracted by any process or cause whatever, that moment vapor ceases to be vapor, and is condensed into water again. This is proved by the

condensation of vapor or steam, in a low pressure engine, for instance, where, by the abstraction of its caloric by cold, it returns to water.

Now, what takes place during a thunder storm, after a hot sultry day, in which vast quantities of vapor were generated, and with which vast quantities of caloric rose to keep it in a state of vapor — what takes place, we ask, during a thunder storm at such a time? Why simply this. Clouds that are charged with caloric, some plus and others minus, or some positive and others negative, are drawn together, by the strong attraction of opposite polarities, two clouds, having an affinity for each other, rush together — the caloric which kept the vapor in a state of vapor, is thus given out from one to the other — explosion takes place — the cause which produced the vapor, and kept it so, having vanished, it is condensed, of course, into water, and being then heavier than the surrounding medium — heavier than the circumambient atmosphere, which before sustained it, it is immediately precipitated to the earth by gravitation, in the form of showers.

If a thunder storm be watched, during the process of nimbification, it will be seen that little dark clouds seem to congregate from every point of the compass, sometimes, and will conglomerate and thicken into deeper and deeper density and darkness, those, which have the least caloric run the lowest, while those which have the greatest quantity, run the highest; as they come parallel to each other, the lower strata will lift,

while the upper will settle down, being attracted by each other, until they come within striking distance, when the plus of the upper strata is given out to the minus of the lower, in the form of an explosion, and, during this concussion, a large share of the caloric, which was treasured up in the vaporous vesicles of both clouds, is abstracted in thunderbolts, and thus copious discharges of condensed vapor or water follow each flash.

This accounts for the reason why the bolt, most generally, passes downward from the cloud to the earth. The upper strata being plus, gives out its caloric to the lower, which is always relatively minus, and, therefore, the scathing fires of heaven oftener leap downward than in any other direction.

Lightning, then, or the electricity of the clouds, is nothing more nor less than caloric, abstracted from vapor by strong chemical affinities, and by explosion. It is radiant caloric, and caloric is electricity. We believe that no philosopher, or chemist can account for all the phenomena of the thunderstorm, and of the lightning, in any other way.

To show that we stand not alone in the advocacy of such sentiments, we will quote from that rare and excellent work by Dr. Metcalf, entitled a new theory of terrestrial magnetism.

"It was observed, long ago, by Dr. Franklin, that masses of vapor in different states of electricity, attracted each other far beyond what he called the striking distance.

"It has probably been remarked by every person of observation, that light masses of vapor from the ocean, on approaching a mass of colder vapor from the northern points of the compass, approximate each other with accelerated velocity, when the colder current of vapor attracts caloric from the warmer; and it is condensed into a hazy mist or cloud.

"This is the rationale of ærial condensations.—When a cloud is once formed, having parted with a portion of its caloric, *it is minus* in relation to all uncondensed or transparent vapor, which is plus. So that it becomes a centre of attraction, drawing to it successive masses of vapor, and abstracting their caloric, by which a perpetual condensation or nimbification is kept up, until an equilibrium is restored.

"It would seem obvious to the most superficial observer, that caloric is the cause of evaporation, inasmuch as the greatest amount of evaporation takes place in regions which receive most of the sun's heat. We may form some idea of the vast amount of caloric contained in atmospheric vapor, when we reflect, that a pound of vapor will raise the temperature of a pound of water nearly 1000 degrees — that its bulk is increased about 1800 times in passing from a state of water to that of vapor, and that all the rivers of the earth are supplied by its precipitation.

"What then becomes of all the caloric which must be given out during the condensation of this vapor? We know that thunder and lightning are most abundant in tropical regions, and during hot, sultry weath-

er in the middle latitudes. Hence we infer, *that the caloric of vapor, when greatly accumulated, is given out rapidly, in the form of electricity, on approaching a colder mass of vapor, which is negatively charged with caloric.*"

But it may, in this connection, be asked, what causes rain, when lightning is not visible. The caloric is given out gradually, and, in such a volume that it is latent. This is either done by the vicinity of cold and warm masses of vapor, or the attraction of mountainous ridges, or of the minus earth.

If this be true, we can see, at once, the reason why, upon the great desert of Zahara, where there are no mountains, and where the earth is almost always plus, it rarely, if ever, rains. The earth, being plus, and imparting caloric to the masses of vapor, as they float over it, rarefies them, and makes them float *higher*, rather than aids in their condensation. It would be utterly impossible, therefore, for it to rain oftener upon that desert.

The same cause dissipates all appearances of rain in certain sections during the prevalence of a drouth, so that showers will pass round day after day, each side of them, and seem to shun them. The earth has, in those sections, become plus and rarefies the clouds, as they pass by, floats them higher, and *prevents* condensation. As a general occurrence, such spots are encroached upon *gradually* by showers, until they are, at length, made minus, and then they are visited by the refreshing rain.

Could a large tower be erected, some one or two thousand feet high, in the very centre of the great desert of Zahara, and could its top be kept filled with *ice*, it would be the cause of the *perpetual* nimbification of clouds, by its abstraction of their *caloric*.—The consequence would be that it would be visited with frequent and vivifying showers.

The sun is the great fountain of light. Were it, however, extinguished, as in Byron's poetic dream on darkness, there would be neither heat nor electricity, and on the other hand, were there no heat nor electricity, there could be no light; for light is necessarily produced by the heat, which is indispensably requisite to render substances combustible, and, without which, they would not ignite, nor become combustible, nor luminous at all. They are inseparable from each other, and from electricity, and if you destroy the existence of the one, by the same process, you destroy the existence of all.

The fact is, the sun, which sends forth its streams of light and heat, is the great fountain of electricity —the great galvanic battery of the solar system.—Could it be stripped, at once, of those splendors, which sweep incessantly over the vast domain of its dependent worlds, and be left a dark, cold, opaque body, what think you, would be the consequence? Why, in less than twenty-four hours, yea, in less than twelve hours, this globe would become a solid mass of ice, from surface to centre, as well as every other body of the solar system. The very atmosphere would be

congealed into an iceberg. The heart of nature would cease to beat. The pulse of nature would stand still.—The powers of nature would all be palsied, chilled, and frozen to death. In such a supposed contingency, the orbs, if they moved at all, would wander, cheerless, black and without order, through the vast expanse of desolation, dashing madly against each other, in their blind and ungoverned career.

Or else, as is most probable in such a contingency, all motion would be stagnated, and every energy, every muscle, every nerve of the universe would be withered, stiffened, clothed with the rigidity of death. All sound would die away upon the palpable blackness of chaos. No elastic medium would convey the tones of harmony by its vibrations. All nature would be dumb.

While thinking upon this subject, I have permitted imagination, sometimes, to have unfettered sway, and to sketch the gloomy picture of the reality of such a supposition. In doing so, no description of the scene which I could paint, seemed so graphic, as the language of Byron's poetic dream on darkness, when

"———The world was void.
"The populous and powerful was a lump,
"Seasonless, herbless, treeless, manless, lifeless,
"A lump of death—a chaos of hard clay.
"The rivers, lakes and oceans all stood still,
"And nothing stirred within their silent depths.
"Ships sailorless, lay rotting on the sea,
"And their masts fell down piece meal—
"As they dropped, they slept upon the abyss without a surge.
"The waves were dead. The tides were in their graves.
"The moon, their mistress, had expired before,
"The winds were withered in the stagnant air,
"And the clouds perished. Darkness had no need
"Of aid from them—SHE WAS THE UNIVERSE."

This description, or a description like this, though almost horrid enough to make the blood run chill, would be no fiction. Should the light and caloric of the sun be abstracted from the universe, there would be no electricity. It would, with the rapidity of a flash, complete its circuit, and perish with its cause. It could be no longer excited by friction. No galvanic arrangement of metalic plates, could produce it.—And then, motion would cease. — All life would instantly become extinct, and darkness and death would reign triumphant and universal.

LECTURE IX.

THE CAUSES OF MAGNETIC ATTRACTION, THE AURORÆ, GRAVITATION, COHESION, AND THE MOTION OF PLANETS DEMONSTRATED BY A VARIETY OF ARGUMENTS TO BE ELECTRIC AND IDENTICAL.

In view of the facts and arguments, which have already been submitted to the reader, we shall now consider it a conceded point, that we have *proven the identity between solar light, caloric and electricity.* To test still farther the correctness of the principles advocated, we will proceed to account, if possible, for certain mysterious and hitherto inscrutable phenomena, which can be satisfactorily accounted for, if our positions be, at all, tenable.

There have, for ages, been certain vague and indefinite ideas, floating in the public mind, respecting the causes of magnetic attraction. While some have thought, that there was a certain incomprehensible control over the needle of the compass exerted by the north pole star, others have approached somewhat nearer to scientific accuracy, by ascribing this controling influence to terrestrial magnetism. But *how* terrestrial magnetism is produced, and by what laws it is governed, the latter class have been about as much in the dark as the former. But, if the positions we have assumed be true—if solar light and

heat be electricity, and, if the sun be its fountain, we have a key, which will unlock all this mystery, which has hitherto been so inscrutable. To this important and useful purpose we will then apply it.

How, upon the theory, that the sun is the fountain of electric influences, is terrestrial magnetism accounted for? The sun being the great galvanic reservoir, pours its stream of light and heat, *vertically*, upon the space embracing 47 degrees of the earth's middle regions, or 23½ degrees each side of the equator, constituting the torrid zone. Let the temperature of the other zones vary as it may, the heat of the torrid is always uniform, and always excessive compared with either the temperate or the frigid zones. Thus the torrid regions, by being more directly under the influence of the sun's rays, become more deeply *electrified*, than either the temperate or the frigid. What is the consequence? The equatorial regions are *positive* or *plus*, while the polar regions are comparatively *negative* or *minus*. There are two reasons for this. The 47 degrees, or the 3266½ statute miles of the earth's surface, embraced between 23½ degrees of north, and 23½ degrees of south latitude, constitute the bulkiest part of the globe, and, even if the remaining part, including the north and south temperate, and north and south frigid zones, were as directly exposed to the sun's rays, as is the torrid, (which supposition is, however, an impossibility,) the equator would in that case still be plus, and the poles minus, because the torrid regions are the bulkiest,

and receive, therefore, the greatest amount of the electric fluid.

But the principal reason why one is plus and the other minus, is, because the one receives the rays more vertically than the other. Now for the application of an infallible rule. The equatorial regions, being plus or positive, and the poles being minus or negative, there is a mutual attraction of the plus or superabundant fluid of the one, and the minus of the other, upon that immutable and universal chemical principle, that opposite polarities, or a positive and negative always attract, or that caloric always seeks to keep up an equilibrium or restore it when disturbed.

Besides, from this immutable and universal law of caloric, to keep up or restore an equilibrium, its particles, if they have opposite polarities, and if the plus end, in radiations, or emanations, always moves first, must present, at the equator, their minus polarities to each other, and of course, be continually repelled outward each way toward the poles.

So, then, there are actually two forces operating upon the superabundant electricity or caloric of the equator. And what is the consequence of the combined action of these two forces? Why, there will be two strong currents of electricity, rushing continually, with lightning speed, from the equator, each way, and these currents will, if this theory be true, run towards the point of greatest cold, north and south, instead of the geographic pole.

Some, perhaps, might contend, that if the streams of caloric constitute the directive power, which is exerted, by some agent over the needle of the compass, they must move spirally, in order to produce that influence, which is actually exerted. Such may confidently infer this, from the fact that certain experiments have been made, which would seem to prove it. A sheet iron globe has been constructed, and so wound spirally, from the north to the south pole, with insulated copper wire, that it would make the needle arrange itself north and south, whenever the galvanic current was sent through the wire from one pole to the other, by connecting the wires at the two poles with the poles of the galvanic battery.

But the inference, that such must be the spiral course of the electric current around the earth, by no means follows from this experiment; for, it must be recollected, that there are two different currents, or two currents running in opposite directions from the equator to the poles, with their polarities arranged, of course, in opposite directions, the same, precisely, as if, from the equator towards the poles of such a hollow sphere, two currents should be sent in opposite directions from two galvanic batteries. By such an experiment it could be demonstrated conclusively, that the needle would arrange itself north and south, without having the galvanic fluid circulate around spirally.

But it would not discredit the correctness of our theory at all, if it were necessary that there should

be spiral currents, for there is, doubtless, a *minor* current, running spirally around the earth, from west to east, owing to the fact, that, by the diurnal revolution, that side of the earth which is in darkness, is relatively minus, when compared with that part which is under the immediate influence of the sunlight.

Now, then, for the explanation of magnetic attraction. It has been ascertained by experiment, that currents of electricity will influence the needle. The reason, then, why the north pole guides the needle when north of the equator, and the south pole when south of the equator, is perfectly obvious. These currents of electricity, rushing from the equator to the poles, constitute what is called terrestrial magnetism. They give direction to the needle of the compass. As the point of greatest cold varies, so they vary, and as they vary, so the needle varies. Were the geographic pole of the earth the point of attraction, as has been supposed by some, the needle would *never* vary *at all*, but, as it is, it varies both diurnally and annually, because there are causes always operating at the north pole to change the point of greatest cold, particularly in the summer season, when the floating icebergs or ice islands of the Artic are continually changing their position.

There are other mysterious phenomena which can be rationally and philosophically accounted for, *only* upon the supposition, that there are such currents of electricity, as we have been describing. They are the Aurora Borealis and Aurora Australis, or the nor-

thern and southern lights, for there are southern lights as well as northern. If caloric be electricity as we have supposed, and there are currents passing from the torrid to the point of greatest cold in the frigid zone, the question arises "what becomes of this electric fluid, when it arrives at that point of greatest cold?" Why, it streams up into the rarer regions of the atmosphere, and in its return to the equator, it spreads out into the lambent, waving light, exhibited by the aurora, the appearance being the same, precisely, as electricity exhibits, when passing through an exhausted tube, the same cause—the rarity of the atmosphere, operating in both cases, to produce a luminous waving cloud, which proves that they must be identical.

As we progress in the investigation of this subject, we find evidence accumulating upon evidence—all linked together, and all sustaining the truth of our main proposition.

Captains Parry and Ross ascertained, in their expedition to discover a northwest passage, that the focal point, from which streams upwards the Aurora Borealis, was exactly the point of magnetic attraction, for, when sailing over that point, the dipping needle stood exactly perpendicular, while the horizontal needle would not traverse at all, but would remain in any position in which it was placed. When west of that point, their dipping needle would incline to the east, when east of it, it would incline to the west. They occasionally found that the focal point, or the point from

which the Aurora Borealis streams upward, was south of them, and in that case the north pole of the needle turned round and pointed southward, so that, let them move where they might, its guiding influence on the compass was still the same.

They also ascertained another important fact—that this point of attraction was comparatively that of the greatest cold.

All these facts combining their evidence, and sustaining that of each other, can there be any rational doubt, but that the caloric of the equator is electricity?

See how admirably these facts are linked together, and how each sustains the ultimate conclusion. Caloric streams down from the sun—deeply electrifies the equatorial regions—by a law of nature rushes towards the greatest cold of the poles—guides the needle invariably towards the greatest cold—streams upward, as it passes out from the magnetic pole—rises into the rarer or thinner regions of the atmosphere, and, like electricity in its passage through an exhausted tube, spreads out into a luminous cloud, and forms the Aurora Borealis at the north, and the Aurora Australis at the south. Now, can there be any stronger proof or any greater accumulation of proof, that caloric is, in fact, electricity, short of actual mathematical demonstration? One, who could not be convinced by such an array of facts, each supporting the other, could hardly be convinced, we should be inclined to suppose, by the evidence of his

senses. He would be like that ancient sect of sceptical philosophers, who doubted every thing—even their own identity.

In continuation of our explanations of various phenomena of nature, which have, heretofore, been left unexplained, or enveloped in a metaphysical fog, we would remark, that there are yet other important and essential links, in the chain of evidence, which we have been linking together, all of which will have a tendency to make the logical accuracy of our deductions more clear, and our conclusions more and more undeniable and convincing.

Gravitation, another imponderable principle of nature, is one of those links—a link too which, so far from diminishing or impairing, in the slightest degree, the strength of the previous chain of deduction, adds to it increasing power of tenacity, and resistance to efforts of prejudice or scepticism to break it—a link, which is intimately connected, as we shall attempt to show, with the mysterious power of electro-magnetism.

No topic, in the whole range of the sciences, has, heretofore, seemed to students more unaccountable—more involved in a dark and misty shroud of uncertainty, than gravitation. Upon what known philosophical, astronomical, or chemical law, bodies, within a certain distance, are attracted *towards* the earth, has, for a long time been regarded by the learned and treated, as an inexplicable enigma.

It is no solution of the riddle—no satisfactory ex-

planation, to affirm, that it is *attraction.* If the attempt be made, by any one, so to define it, the question instantly suggests itself to the unsatisfied mind of the dilligent enquirer after scientific truth—what *causes* this attraction—why do all bodies, when supported in mid air, fall *to* the earth, instead of flying off in a tangent—*away* from it, into space?" We answer, that there must be some *definite* reason existing in the nature of things for this phenomenon. What, then, is that reason?

It will not avail anything, as we have seen, to say, that it is attraction, or, that it is the attraction of gravitation. This method of solving the enigma would only be reasoning in a circle, as logicians would call it—would be only giving a simpleton's solution, by saying that a thing is so, *because* it is so. It conveys no definite idea to the mind—is referable to no general scientific law. So far as purposes of lucid and perspicuous illustration are concerned, it might just as well be said, that attraction of *attraction* causes that known disposition of bodies to seek the earth, as to be said, that the attraction of *gravitation* causes it, for, the words, indicating or defining the *cause*, are, in both cases, equally vague, having no definite idea attached to either of them. If we are told that all bodies of any bulk and density, have an inherent tendency to approach other bodies of matter larger and heavier than themselves, upon the principle of attraction, and that this is the attraction of gravitation, is it any explanation at all? Certainly not. Instead

of throwing any light upon the subject, it is only the substitution of one vague term, for another term equally vague. The question still rushes upon the unsatisfied mind, with undiminished force—"What *causes* this gravitating tendency? Why do bodies tend downward towards the earth instead of upwards from it?"

Shall it be said that it is an insolvable mystery, which is beyond the ken of human investigation, and so let it pass? Will men permit themselves to be thus baffled in their researches into the nature and causes of things, by difficulties, which, perhaps, a stern and unbending perseverance might overcome? This would be neither wise nor manly. There is not, we are persuaded, the cause of a single solitary effect of any kind in the universe, except the great uncreated cause of *all* effects—or, in other words, a single secondary cause of any effect whatever, which may not, in time, by patient and persevering investigation —by comparing laws and agencies and influences, be satisfactorily ascertained.

What, for instance, is a fundamental law of electrical attraction?—Why, an excited body, attracts an unexcited body, that approaches it, in exact proportion to the square of the distance. Iron, when temporarily magnetised by the galvanic or electric fluid, or steel, when permanently magnetized, attracts contiguous metals precisely in the *same proportions*, and, although magnetism and electricity were once thought to have no sort of alliance with each other, yet, they

are now proven, beyond controversy, to be but one. And what may we infer from this coincidence between the two, and the identity of their laws and agencies? Why, that any other imponderable, which shall exhibit the operations of the *same governing laws,* without a *shade* of difference, may, also, yea, and will be found to be produced by the very same *cause,* upon the immutable principle of nature, that like causes produce like effects.

Here then we have a key to unlock the mystery of gravitation—a rule to solve every enigma, and every difficulty satisfactorily. The attraction which the earth exerts over loose bodies above its surface, is governed by the very same laws precisely, as magnetism and electrical attraction—it draws them, with a force, which varies in inverse proportions according to the squares of the distance.

Gravitation, then, is nothing more, nor less, than terrestrial magnetism, produced, as all magnetism is produced, by electricity, and that electricity, streaming down from the source of all electricity, the sun. Before this theory, every difficulty which surrounds the subject of gravitation, vanishes at once. The phenomena of bodies gravitating towards the earth can be thus accounted for by the operation of known, and acknowledged, and tested scientific laws. The earth is, in fact, a magnet—exhibiting all the properties of a magnet—attracting the needle to the pole like a magnet—drawing bodies to itself with a force precisely conformable to the attractive force or influence of a magnet, is made a magnet by elec-

tricity—and that electricity is the light and caloric that stream from the sun. The attraction of gravitation, then, is the attraction of terrestrial magnetism.

It has been the current opinion, among the mass of the community, and even among scholars, that every thing is attracted towards the centre of the earth, as though that possessed some mysterious, unaccountable power of attraction over substances, (somewhat akin to the unphilosophical opinion, that the north pole star guides the needle of the compass,) and that it increased all the way to that centre. But such is, by no means the case. The attraction of gravitation, instead of being the greatest at the *centre*, is the greatest at the *surface* of the earth.

Were it possible, for instance, to perforate *through* the earth, exactly at the magnetic centre, instead of the geographic, a substance, which might weigh hundreds of tons at the surface, would weigh just nothing at all at the centre. It would be suspended there, were the space large enough, without any apparent support, like a light needle, when suspended within a helix, or coil of insulated copper wire, while passing a current of galvanism around it. And why would this be the case? Because the electrical or magnetic attraction would be equal on all sides of the centre of the earth, and, therefore, a substance, which would weigh several tons at the surface, would there be perfectly balanced, without support, and would, in that position, weigh just nothing at all, since all weight depends upon attraction, and that weight is exactly pro-

portional to the attraction. As the power of the attraction is equal on all sides of the centre of the earth, and, as attraction *one* way, without a corresponding attraction the *other*, causes all weight, therefore, a substance at this centre, must weigh nothing, because the attraction being in all directions equal, must be neutralized.

The attraction of gravitation, or, in other words, the attraction of terrestrial *magnetism*, which is the same thing precisely, is the greatest at the *surface* of the earth. It may be asked, then,—"Why do all falling bodies, fall toward the centre?" Simply because the radiations of magnetism obey the same law, precisely, as the radiations of light. The lines of these radii if continued on within the surface, or through the earth, from one side to the other, would intersect the centre, and the attractions of the surface are, therefore, directly *toward* the centre.

From the fact that the radiations of magnetism, obey the law of the radiations of solar light, and all other light,—that is, from the fact that the divergence of the radiations of magnetism is in the exact proportion of the squares of the distance, the same as the divergence of light, gravitation, therefore, attracts all bodies around it, in proportion to the squares of the distance of those bodies. So that the organic laws of magnetism, light and gravitation are the same, and, like *laws* produce like effects as well as like *causes*.

Before dismissing the interesting subject of gravitation, we would express our belief, that it is a proposition capable of demonstration, that an increase of the material of the earth, would increase its attraction in precisely the ratio of the increase of the attraction of the magnet, by the increase of *its* material. Were the material of the earth *doubled*, for instance, its attraction would be *quadrupled*, precisely in accordance with the law of the divergence of light, or the radiations of electricity. Consequently the weight of all bodies upon its surface, of the same bulk and density, would, in such a supposed contingency, be quadrupled in accordance with an immutable law.

Now, from all that has been said, does it not appear perfectly evident, that gravitation has a cause, as definite and as easily explained, as magnetism; which cause is precisely the same. The great magnet of Professor Henry, for instance, to which we have already alluded, would, when fully charged with the galvanic current, *neutralize* all the power of the *earth's* gravitation, and make a body gravitate *upwards* from the earth, with a power equal to *two or three tons*.—And why? Simply because a vast volume of electricity was accumulated there in a small compass, by means of the insulated copper wires, around which the galvanic fluid circulated. Electricity or light, then, we can legitimately conclude, is the *cause* of gravitation.

LECTURE X.

THE CAUSES OF MAGNETIC ATTRACTION, THE AURORAE, GRAVITATION, COHESION, AND THE MOTION OF PLANETS DEMONSTRATED BY A VARIETY OF ARGUMENTS, TO BE ELECTRIC AND IDENTICAL.

The attraction of cohesion has the same cause, as the attraction of gravitation. They are both doubtless, produced by that electric cause, the light and caloric of the sun. The one is the attraction between *large masses*, and the other between the component *particles* of those masses, the one attracts at great distances, and the other at insensible distances—their attractions are, therefore, the same in essence, though not in volume or degree. What holds the armature of Henry's large magnet, when charged, but the simple power of cohesive attraction between the particles of the iron, which composes the material of the magnet and armature, which cohesive power is caused by electricity? We believe it is nothing else. The same power, precisely, holds the particles of all bodies together, and that power of cohesive attraction varies often as the amount of *latent caloric* varies. Abstract the latent caloric of iron, for instance, by intense cold, or by any other cause, and you, in a proportionable degree, destroy its cohesive attraction, and

make it brittle. This is proven by the ease with which iron is fractured, in the intense cold of the winter.

By hammering iron when cold, or by rolling it in a rolling mill, it will also become brittle. And why? Because the caloric, which constitutes cohesive attraction, is pressed out upon the surface, by closing the pores. This is proven by the fact that caloric accumulates upon the surface, in proportion as the pores of the iron are contracted by the rolling mill or the hammer, which drive out the latent caloric.

The various phenomena of capillary attraction can be referred to the same cause, as cohesion — to the caloric, that electrifies all substances under its influence. The tallow that composes the candle, for instance, is drawn up into the wick, during combustion, by capillary attraction, and that attraction is caused by the caloric set free during ignition.

We are well aware that many objections to the validity of our positions can be started by fruitful imaginations, which may appear plausible and seem to conflict with the conclusions which we have drawn, but which must be deceptive, since the laws of nature do not clash, and, if some of the reasons, and the modes of her operations are beyond the ken of the acutest and most penetrating scrutiny, it amounts to no conclusive proof that we are incorrect. The question is simply this. Have our deductions appeared rational, and in accordance with known and tested laws, and have they been amply sustained by an accumulation

of appropriate facts? If so, we are under no obligation to explain mysteries in the *essential attributes* of an agent, while we are attempting to trace merely the *effects* of that agent, for most of those objections, which are or may be started, will be found, upon close scrutiny, to relate to *essence* rather than to the "*modus operandi*" of that essence.

Such questions as these, for instance, may be asked by the caviling objector. If caloric be the *cause* of cohesive attraction, why will its accumulation entirely *destroy* cohesive attraction, as in the instance of all melted metals? Or, if caloric be electricity, and, if electricity be magnetism, why does not its accumulation around the large galvanic magnet, make that large magnet hot? Or, why will this agent, under one set of circumstances, produce an effect, and under another, *destroy* that same effect it produces, if "like *causes* produce like *effects*?" These, and a thousand other questions, might be proposed by the objector, which are more easily asked than answered.

But, to show that they relate to *essence*, we will ask some questions equally puzzling, about electricity, where there can be no mistake about the identity of the agent. Why will the very same current of galvanism produce *both* an *acid* and an *alkaline* taste? Why will electricity, under one set of circumstances, make a magnet, and why, under other circumstances, will it *destroy* that same magnet. It will be readily perceived, that it is much easier to *ask* questions than to *answer* them, and that such questions refer

rather to an explanation of *essence* than of *effect*. That *essence* of electricity, we never attempted, nor have we ever proposed, to explain. It is a wonderful agent, and as mysterious as it is wonderful. Its effects are varied by countless myriads of modifications, and these effects, we investigate, rather than the inscrutable reasons, why those modifications should be so multitudinous, and why they should, in some cases, appear to clash.

To show that we stand not alone in the advocacy of the opinion, that cohesive and capillary attraction are produced by caloric or electricity, we will quote from Metcalf's "New Theory of Terrestrial Magnetism." Speaking of caloric, he says:—"It seems to be a general law of this subtle element, that it repels its own particles, and is attracted, though unequally, by all other matter, with an increased ratio, as the squares of the distance diminish.*

"From which it follows, that when caloric is withdrawn from a body, that body has a stronger affinity for caloric, than one which is filled with it; and two bodies charged with caloric, one plus and the other minus, will attract each other with a force proportioned to the different quantities of caloric which they contain, and to the rapidity of its conduction from one to the other.

"An experiment, which I inadvertently made when a child, strikingly illustrates this principle. On the

* We do not believe in the above proposition, so far as reciprocal attraction is concerned. This would, as we have elsewhere shown, destroy the "vis inertiæ" of ponderable matter.

morning of "cold Friday," as it was called through the Western country, I applied my tongue to a plate of cold iron, while the mercury was about 15 degrees below zero, when it adhered with such force that the skin was removed on separating it. Captain Scoresby relates, that frequently such was the intensity of cold in the Arctic seas, that the hands of the sailors adhered fast to whatever metals they touched.

"In such cases the temperature of the living body is from 115 to 140 degrees higher than that of the metals:—in other words, the living body is charged plus, while they are minus; and the attraction continues until the equilibrium is restored, when it ceases.

"The same attraction takes place, when the hand is applied to metals heated greatly above the temperature of the living body; and for the same reason, one of the two bodies being charged plus and the other minus.

"When the temperature of metals is greatly reduced, they become brittle, so that a slight blow will fracture them; the same effect is produced on iron by hammering, which presses out, and expels from it, that portion of caloric, which is necessary to its cohesion and malleability. Hence it follows, that a certain amount of caloric between the particles of matter is requisite to maintain their cohesion; but when the amount of caloric is increased beyond a certain extent, it separates the particles, and thus diminishes, or overcomes, the power of cohesion.

"A great variety of facts may be adduced, to show,

that *capillary attraction*, is owing to the operation of the same law. For example; if a piece of sugar be put into a glass of water, a portion of the caloric of fluidity leaves the water, enters among the particles of sugar, and diffuses itself equally throughout the whole. During this absorption of caloric by the sugar, the temperature of the resulting mixture is somewhat reduced, proving that, in relation to the water, the sugar is minus or negative, and the water is plus or positive.

"If the piece of sugar be cut into a cylindrical form, of one or two inches in diameter and five or six inches long, and one end of it only be inserted into a glass of water, the caloric of the positive fluid being *strongly* attracted by the negative sugar, pervades it rapidly throughout, until the equilibrium is restored, when the entire mass is dissolved.

"M. Lehot found by experiment, that under the same pressure, water rises higher in vertical capillary tubes, as its temperature is elevated. (Bibl. Univers. Mars. 1820, p. 225.)

"The phenomena of a burning candle illustrate the agency of caloric in producing capillary attraction in a very striking manner. The wick is ignited, the tallow rendered fluid, and attracted by caloric so as to furnish a continual supply of combustible matter to the wick, which is decomposed and expanded into flame or light. The force and rapidity of capillary attraction, all other things being equal, are in proportion to the amount of heat given out in the wick.

"Capillary and cohesive attractions are only modified effects of the same cause. It is the attraction of caloric for the particles of water, that holds them together; that gives its drops their globular form; as it is the attraction of caloric for porous solids, and capillary tubes, that raises the water above its ordinary level."

If light and caloric then be electricity, and the sun be the sole fountain, from which it issues, as we have attempted, in previous lectures, to demonstrate, then its influences over the planets, that revolve around it, must also be an electric influence. If their motions are produced by the influence of the sun, then, those *motions* must be governed by the laws which govern the electric agent.

We approach the discussion of this subject, with the feeling, that it is the most important, as well as the most interesting of any contained in the whole series of lectures. If we shall demonstrate, that the revolutions of all the planets, both diurnal and annual, can be philosophically accounted for, in accordance with those organic laws of electricity, which have been, and may be ascertained definitely, in the laboratory, in their action upon pith balls or electrometers, then will our opinions upon this subject be triumphantly sustained beyond the influence of cavil, and their correctness incontrovertibly proven. But, if we shall not be able to demonstrate such an identity, then will it appear conclusive, that we have been indulging in

philosophical dreams, or baseless chimeras of the brain.

What then are the forces, which electricity exerts over pith balls? They are two, which, as we have, heretofore, abundantly shown, have their basis in the inherent organic laws of this agent, and depend always, for their development, upon a plus and minus.

And what are the two forces, which have ever been supposed to govern the motions of the planets? Why they are, what philosophers have denominated, centrifugal and centripetal forces. The meaning of the one is, a tendency to fly from a centre, and that of the other, a disposition to seek the centre. Now these terms are, as any one must see, exactly equivalent to attraction and repulsion. Centrifugal is repulsion and centripetal is attraction. So then, we find, that we have to bring to our aid no new forces, if we adopt the hypothesis, that the influence of the sunlight upon the solar system, is electric, since its two organic forces, correspond exactly to the centrifugal and centripetal, of all standard works.

How then is the diurnal motion of the earth, for instance, produced upon this hypothesis, taking the movements of this globe for example, since they are more familliar than those of any other planet. Why, simply in this manner. The sun illuminates one half of the surface of the globe, while the other half is in darkness. That hemisphere, which is in darkness, is relatively minus, when compared with that which is illuminated, and so, vice versa, that hemisphere which is under the direct influence of the radiance of the sun,

is relatively plus, while the other is minus. The plus of the one side will increase from morning until sundown, and the minus of the other from sundown until morning. This is in accordance with that tested fact, that, if any substance be exposed to an electrifying cause, it becomes plus, and the longer it is exposed to that cause, the more highly plus it becomes, and so, on the contrary, if any substance be removed from the electrifying influence, it becomes minus, and the longer it is removed, the more deeply minus it becomes. Now, what is the legitimate result of such a condition of the earth? That part of the earth, which has been longest in the sun's rays, has come, as we have said, to a highly plus or positive state—that is, it has come to that state, in which, throughout the torrid regions and part of the temperate, there must be an outward emanation, which constitutes a plus or positive, since any substance, exposed, for any length of time to an electrifying cause, must become positive.

By an immutable law of electricity, two positives repel. Therefore, that part of the earth, which has been longest in the sun's rays, having come to a positive condition, is repelled by the positive sun. But that part which has been the longest removed from the direct influence of the electrifying cause, and has, therefore, come to a deeply negative condition, would of course, be attracted by the positive sun, since a positive and negative always attract. If this were the true principle of the revolution of the earth upon its axis, the plus part of the earth must be always rolling

away from the sun, while the minus part must always be moving *towards* it, from the fact, that two positives always repel, and a positive and a negative always attract. And this *is* the case, not with the earth only, but with all the planets, which compose the solar system. That part of all of them, which has been longest *in* the sun's rays, is always rolling away from him, while that part, which has been longest *out of* his rays, is always rolling towards him. In producing the rotary motion of the earth, then, upon its axis, it is evident that the sun exerts two forces upon it, the one of attraction and the other of repulsion, which would cause its diurnal revolution, since, if you strike a ball on each side with equal force, and in opposite directions, you give it the rolling motion.

The earth, then, revolves on its axis daily, by the influence of the two forces of attraction and repulsion, exerted over it by the sun, and those are precisely analogous in every respect, to those of electricity.

If this be not the precise influence which the sun exerts over the earth, in the production of its diurnal motion, what is that influence? It is universally acknowledged that the sun governs all the motions of the earth. But, while such an acknowledgment has been made, there seems to have been no clear or well defined idea, in the minds of those who have made such an acknowledgment, as to what constitutes that ruling power. They have almost universally taken it for a conceded proposition, that such a ruling power of nature controls the movements of this globe of

ours, but *how* it exerts such a control, they seem scarcely to have taken the trouble to enquire.

But, if the sun governs the motions of the earth, it governs those motions in accordance with *uniform, well-defined and immutable* laws. Now, if any one affirm that the sun controls the movements of the earth, he is bound to explain the principles of that government. If he cannot, how does he know that there is any such government *at all.* He has no right to assert that one thing is governed by another, without he can give some definite reason, or reasons, *why* he draws such a conclusion. Nor has he any right to object to conclusions, which others have drawn from well defined premises, and deductions founded in reason, and sustained by well attested facts.

We, for instance, have assumed the proposition to be true, and have endeavored to prove it, that electricity is the cause of all attraction and repulsion, upon both a large and small scale, and, consequently, of all motion among spheres, as well as atoms, and that the sun is the fountain whence it originates. As part of a connected chain of antecedents and consequents, or of causes and effects, we have drawn the legitimate conclusion, from the practical results of this theory, that the sun governs the earth and the other planets of the solar system by an electric influence. That influence has been *tested* in the laboratory upon pith balls, and is, therefore, acknowledged by all, who pretend to any very extensive attainments in science.

Now we have shown that the diurnal motion of the

earth can be produced by the streams of electrifying sun-light, *precisely* in accordance with those known and tested and universally acknowledged electric influences, which are of every day occurrence, and are familiar to every school boy. And if objections be urged against such conclusions, those who urge them ought, certainly, to be prepared to explain the laws by which the sun governs the earth, more satisfactorily and plausibly, or else forever hold their peace, and acknowledge their incompetency to do it; for the old stereotyped method of explanation, by referring the whole to the influence of the centrifugal and centripetal forces, without explaining *how* those two forces are produced, will not answer — will satisfy no enquiring mind.

Feeling the force of the deductions which we have drawn, and seeing the impossibility of denying our conclusions, if our premises be correct, some may be roused by the impulse of their alarmed prepossessions, to attack some of those premises. They may deny that the earth becomes minus during the night, and, therefore, infer that there are no two forces of the kind we have mentioned. But such cannot have investigated the subject at all. The earth is a rapid radiator of caloric, and, therefore, when the cause of it is removed, it rapidly dissipates. The consequence is, that, although the emanations of caloric are outward from the earth during the day, especially in the torrid zone, they are inward from the atmosphere to the earth at night, as is proven by the deposits of dew, for

these deposits result from the abstractions, by the minus earth, of the caloric of the vapor, which was generated in the day time, and rose from the earth by the force of emanating or plus caloric. The passage of caloric is, therefore, into the earth at night, from the surrounding atmosphere, and of course, presents its minus polarities, as all inward currents do. This objection falls, therefore, to the ground, for the want of the shadow of a support, and so would every other objection, we believe, because our explanation of the phenomena of the revolution of the earth is in accordance with the immutable laws of nature.

As we have already remarked, all the other primary planets obey the same laws precisely, or are governed by the same influences, in their rotary motions upon their axis, as the earth.

An objection may, however, be urged against this conclusion, from the fact that there is no uniformity in the diurnal revolution of those, whose motions have been ascertained with certainty, since Venus turns on her axis in twenty-three hours and twenty minutes, the Earth in twenty-three hours and fifty-six minutes, Mars in twenty-four hours and thirty-nine minutes, Jupiter in nine hours and fifty-five minutes, and Saturn in ten hours and sixteen minutes.

Now, why is there so much dissimilarity in the revolution of these planets, if there be a common cause for it, and if the laws which govern that common cause are invariable? It must be owing to the different materials which compose them, to their different

powers of radiating caloric, to their different distances from the sun, and also, doubtless, to their bulk.—Venus is some twenty-eight millions of miles nearer to the sun than this earth, and its day is thirty-six minutes longer than ours. Upon the supposition that the power or capability of each planet to radiate caloric decreases in exact proportion as the squares of the distance from the sun increase, about which we shall soon remark more at large, then the revolutions of each primary planet would be regulated in exact proportion to bulk and distance.

The difference between the relative distances from the sun of the Earth and Mars, is forty-eight millions of miles, and the difference between the time of their revolutions is forty-three minutes. Now, if we take those three planets, Venus, the Earth and Mars for data, whereupon to make our calculations, we can determine, with mathematical certainty, whether any other causes than mere bulk and distance, influence the rapidity of their revolutions.

The difference between the bulk of Venus and the Earth, in diameter, is two hundred and forty miles, between their distances from the sun is twenty-eight millions of miles, and between the time of their revolution, or the length of their day, is thirty-nine minutes, while the difference between the bulk of the Earth and Mars, the next planet, is three thousand seven hundred and thirty-nine miles, between their distances, is forty-eight millions of miles, and their time forty-three minutes. Into this account is to be

taken, the bulk and influences of the Moon, which the Earth carries along with it.

Without having space to enter into all the minutia of a mathematical calculation in the present connection, it is our impression that, with these data before us, it can be perfectly demonstrated, that the rapidity of diurnal revolution depends alone upon bulk and distance from the sun combined.

This accounts satisfactorily for the reason why Jupiter and Saturn revolve upon their axes in less than half the time of the revolution of our earth, although the one be three hundred and ninety-five millions of miles further from the sun than the earth, and the other eight hundred and five millions further; — for Jupiter has a diameter about twelve times as great as our earth, making its bulk more than a thousand times greater than this planet, besides carrying with it four large moons, and Saturn, exclusive of the weight of his enormous rings and *seven* moons, is nearly six hundred times larger than the Earth. They may therefore, in exact accordance with our data, both perform their diurnal revolutions in less than half the time of our earth.

Having come, by our deductions, to the conclusion, that the rapidity of revolution depends upon the bulk of the planets, and their relative distances from the sun, we would here remark, that, if the power or capability of the planets to radiate caloric, decreases, according to the squares of their distance from the great centre of the system, then, there is a *definite*

cause why they all occupy just the position they do. Were this the case, they could come no nearer to the sun than they now do, nor could they remove farther away from it, but must remain just in the position they do at present, and have done since creation, so long as their material remains the same, or they have the same power of retaining or radiating caloric.

For, if they should come any nearer, it is evident that they must become plus, and so be driven back, by the repulsion of two positives. And, if they should recede, farther from the centre, they would become minus, and so be drawn to the position, whence they started by the attraction of a positive and negative. It is perfectly evident, then, that the planets are completely balanced in their orbits. They can neither fly away from them, nor can they be drawn into the sun, for the agent, that rules them, and governs all their motions, holds them just where they are, with bonds which cannot be broken, until the final "wreck of matter, and the crash of worlds." Owing to this cause alone, the earth approaches the sun, in one part of its orbit, and is driven back in the other, the two forces, keeping it balanced in strict accordance with that law of caloric, which has a tendency to keep up an equilibrium throughout nature.

Having accounted, rationally, for the revolutions of the planets upon their axes, upon the principles of electrical attraction and repulsion, how shall we account now, for their annual revolutions around the sun. This, we confess, is a subject much more ab-

struse, and the problem is much more difficult to solve. But yet, we believe that it is capable of being satisfactorily solved, in accordance with the very same electrical principles, which we have already fully explained and tested.

But before we proceed to do this, it is necessary for us to state a few facts, which will aid materially in the solution of this problem.

Not only do all the planets revolve one way upon their axes, but they all move in one direction around the sun. Their motions, also, decrease in regular proportions and gradations, as they recede from the sun. Mercury, for instance, moves in her orbit one hundred and eleven thousand and ninety miles per hour—Venus eighty-one thousand—the Earth sixty-eight thousand—Mars fifty-six thousand—Jupiter twenty thousand—Saturn, according to Ferguson, eighteen thousand, and Herschel fifteen thousand.

It will be seen that their movements are regulated by distance from the sun, combined with bulk, and, we believe it to be a proposition capable of absolute demonstration, that the decrease of the motion of all the planets in their several orbits, would be in exact proportion to the squares of their distances from the sun, if they were all of the same bulk and density exactly, taking the present ratio of their movements, as correct data from which to draw conclusions.

Now, then, for the explanation of the annual revolutions of the planets. The sun seems to turn on its axis once in twenty-five days. That may be nothing

but a seeming revolution, owing to the movement of its emanations in vast orbits as we have before remarked, and which would convey that impression to an observer upon the globe; but it may be real. Be that as it may, all the planets move the same way that the sun seems to revolve, and therefore, the same way that its emanations move in their orbits.

Now by the influence of the rays of the sun, moving with lightning speed in their orbital course, must the planets be all moved in one direction, since all their movements, both diurnal and annual, are governed entirely by the emanations of the sun, as we have seen. This is, doubtless, effected by the amazing influence, which, as we have upon a small scale, demonstrated, that opposite polarities have upon each other, in inducing the particles of the electric stream to follow each other, and to move with them either atoms or masses of ponderable matter.

"But why," it may be asked, "does not this tendency of electricity to control both atoms and masses of ponderable matter, drag them outward, exactly in the line of the course of its orbital movements?" Because, as we have seen, if they were moved outward from their present position, they must become immediately minus, and be drawn back by the positive sun. Besides, were not this the case, the inward passage of the electric rays, in their return, as we have before explained, to their source, the sun, being with a lightning speed, as rapid as their outward emanation, may have a tendency, somehow, to neutral-

ize the tangential force, and, at the same time, aid in the propulsion of the planets in their orbits, as the propelling force, if they have any, would be in the right direction.

The eccentric movements of the comets are produced by the operation of the same laws, as the movements of the planets. In the most distant part of their orbit, a thousand millions of miles, perhaps, from the sun, or even more, these wandering stars move very slow, and in the arc of a circle almost immeasurable, having lost their charge of caloric, and become minus. The sun, being positive, and they deeply negative, it begins to exert an attracting influence over them. As that attraction increases, continually, in proportion, as the squares of the distance decrease, they move swifter and swifter, until, as they approach the sun, they sometimes fly more than eight hundred thousand miles an hour. At their perihelion, they are very near the sun, and become highly positive, as they revolve half round in its intense blaze, and are propelled back again into the fields of space with the same lightning speed, that they were attracted towards the fountain of all motion.

In view of what has been said in the preceding series of lectures, how wonderful is the subject of electricity—how various and how magical are its agencies! It streams down in the vivifying rays of the sun—quickens and invigorates the sluggish pulsations of nature—preserves the warmth of vitality—works all the countless myriads of chemical changes—

clothes the cheek with the blush of health—spreads a rich carpet of green over the landscape—dresses the forest in its foliage, and has, no doubt, a direct agency, in the production and continuance of all the forms of both animal and vegetable life.

But there is a reverse to this picture. Not always does it, in the exhibition of its wondrous phenomena, put on an aspect of such blandness and genial benevolence, wreathing itself in sunny smiles. No! Its countenance sometimes gathers either mysterious grandeur or terrific fearfulness. Sometimes it streams upward from the poles, in splendid corruscations, and weaves a bright coronal of lambent light at the zenith. Sometimes it exhibits itself in the effulgence and evanescence of the meteor's flash, and the meteoric shower. Sometimes it leaps out from the dark foldings of the stormcloud, darts downward through the gleaming tempest, and, with a fearful energy, which none else but God can wield, blasts everything it touches. Sometimes it flames athwart the heavens, in the trail of the comet, as it speeds its erratic and lightning course, and makes the nations pale with forebodings. Sometimes it assumes the port, and majesty and terror of the burning whirlwind—rushes forth upon the red wing of the Syroc, and sweeps with desolation, the hot plains of Zahara. Sometimes it musters its almost omnipotent force in the deep caverns of the earth's centre, and makes the earth tremble and reel beneath the tramp of the earthquake; and melts rocks,

and pours rivers of lava from the crater's mouth, and hurls enormous masses of blazing matter above the clouds, and upheaves mountains from the depths of the ocean and piles them in the sky. Such are some of the wonderful agencies of electricity.

FINIS.

reading this volume Feb. 5th 1851 before breakfast: The author has presented some very beautiful thoughts which if carried out with more experiments & facts to prove them may result in our established truths instead of them. The authors appears not to be a scholar enough to carry out his mathematical demonstrations which if carried out would do more to confirm or invalidate his views